ELECTRICAL REVIEW

A WEEKLY JOURNAL OF

ELECTRIC LIGHT, TELEPHONE TELEGRAPH AND SCIENTIFIC PROGRESS.

(Formerly Review of Telegraph and Telephone.)

Vol. 3, No. 20. WEEKLY. | NEW YORK, THURSDAY, JANUARY 17, 1884. | $3 per Annum. Single Copies, 10 Cents.

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Entered at Post Office, New York, as Mail Matter of the Second Class.

THE BRUSH-SWAN SYSTEM.

(*Continued.*)

Another advantage is that no matter what accident or stoppage may occur to engine or machine, the consumer has always at hand a certain supply of electricity ready for use.

What the public has demanded and what Brush would seem to have devised, is a system wherein energy should be so stored that the electric current might be actually waiting to pass, ready to flow at any moment when the channel in which it had to circulate was completed. Happily, there was a way of obtaining an electric current in a very direct manner by means of stored chemical energy. This chemical energy might be dormant for any length of time and give no outward sign of power, and yet in an instant, as by the touch of a magician's wand, it sprang into powerful action. Sir William Thompson had made careful measurements of the energy stored in the Faure cells, and found that one weighing 1½ cwt. could store energy of one horse-power for one hour. Supposing that store cells are applied to produce electric light, at this rate one ton of cells would supply sufficient current for ten Swan lamps during six hours. Two things were clear from this—first, that unless the price at which such cells were sold was much higher than the intrinsic value of the material of which they were made and their simple construction suggested, their cost need not be prohibitory of their use; second, that the bulk and weight of a set of cells to do any considerable amount of work would be too great to admit of the idea that it would be practicable to move them for the purpose of charging. In some exceptional cases the cells might be carried from place to place, just as gas was occasionally carried in bags. It was much more easy to carry the electric current from a fixed and distant dynamo-electric machine to the store cells, by means of wires, than to carry the cells to where the dynamo was, just as it was easier to carry gas to a distant place in pipes than in a metal gas holder.

Now, Brush has arranged his storage system to fill the requirements of electrical lighting, and seems to have, at the same time hit upon an economical means of doing this.

There is no form of energy so easily conveyed to a distance as the energy of electricity, and to think of carrying it about in boxes instead of sending it on its distant journey through wires is to ignore one of its most valuable properties. In every house lighted by the Swan system there will be a fixed set of cells occupying a place, and perhaps also a space not unlike that which a water cistern occupies in some country houses. These cells will be in a communication through insulated and hidden wires, with a main central electric supply, and will either be kept charged by continual connection with the main, as our water cisterns are, and with a regulating appliance equivalent to the automatic feed of a water cistern; or the current will be turned on for a few hours each day until the cells of one district are fully charged, and then the current will be turned on to another district to charge the cells of that district.

The great advantage of the storage battery is that no matter how irregular the charging of the battery may be, its emission of electricity is perfectly steady; no matter how a cistern may have filled, the flow of water from its faucet will be perfectly regular. The great trouble in feeding incandescent lamps directly from a dynamo machine is that the light shows every variation in the running of the engine; every time the belt seam passes over the fly-wheel a tremor in the light shows it; when the engine runs faster or slower, it is perceptible at once. The current used for arc lights would never do for incandescent lighting, owing to its irregularity; but it is just as good for charging a battery as any other current. The plan of the Brush company is, therefore, to put batteries into every cellar and connect them with the street wires which feed the street lamps.

The company is making four standard sizes of battery—five lights, ten lights, twenty lights, and forty lights. The smallest size will occupy the space of a small trunk, and the sizes of the batteries increase in proportion to their power. They can be put in any part of the house, from cellar to garret, or in the vaults under the sidewalks. The current in the batteries will supply the number of lamps they are intended for for five hours. Thus, a twenty-light battery will supply twenty lamps for five hours, or ten lamps for ten hours. A meter registers the flow of electricity through the battery, and also acts as an automatic cut-off when the battery is fully charged. This company guarantees that the batteries will fulfill all the conditions under which they are sold. The cost of the light, according to Mr. Brush, will

BRUSH-SWAN SYSTEM OF ELECTRIC LIGHTING, STORAGE AND POWER.

not be more than that of gas, at which price it is expected to put in batteries as fast as they can be made. The light needed by an ordinary four-story house, twenty-five feet wide, does not average in winter fifteen lights for five hours.

Contracts for lighting by this system have been made with a number of persons. Among other places, the Central Bank, some of the stores along Broadway, the American Safe Deposit Company, and the Bijou Theatre, have been wired by the company for the new light, and are now awaiting their batteries. The Madison Square and McKee-Ranks in Theatres are now lighted from batteries. At the Madison Square Theatre, it is said, the light promises to be twenty-five per cent. cheaper than gas. The Boston factory of the company is now turning out Swan lamps at the rate of 10,000 a week. As there is no work to be done in the streets to introduce this system of lighting, there is no reason why the work should not proceed rapidly after the batteries are received. From the same batteries power can also be taken for running small motors for sewing machines, lathes, &c. The whole system of batteries, lamps, and motors can be seen by any one interested in the matter, at the company's offices, No. 853 Broadway, where they have been in operation all winter.

The difficulty of dividing the electric current for the economical production of incandescence light has been practically solved by the invention of the Swan incandescence light. By its means separate lights of various powers, and applicable to all the uses of ordinary gas burners, or other artificial light, may be produced. The Swan lamp may be fed direct from the dynamo-electric machine, or from secondary batteries.

The Swan lamp is exceedingly simple in its construction, and may be described as follows: A small glass globe from which all the air has been exhausted, and in which is fixed a thin filament of carbon, forming a complete coil, thus giving an extended illuminating power.

On passing the electric current through the carbon it becomes intensely white, hot, and emits a beautifully soft, clear and steady light. As the carbon is not in contact with the air there is no combustion, and therefore, no deterioration of the atmosphere, and the heat given off is almost imperceptible.

The lamp has no mechanism, and, when it fails from use or accidental breakage is as easily replaced by a new one as a candle is placed in a candlestick.

The power of the Swan lamp ranges from three candles to 100 candles, the standard size, however, being sixteen candles, or somewhat more than an ordinary gas-burner.

The Swan lamp has an average life of 1,000 hours of use, but may last many thousand hours.

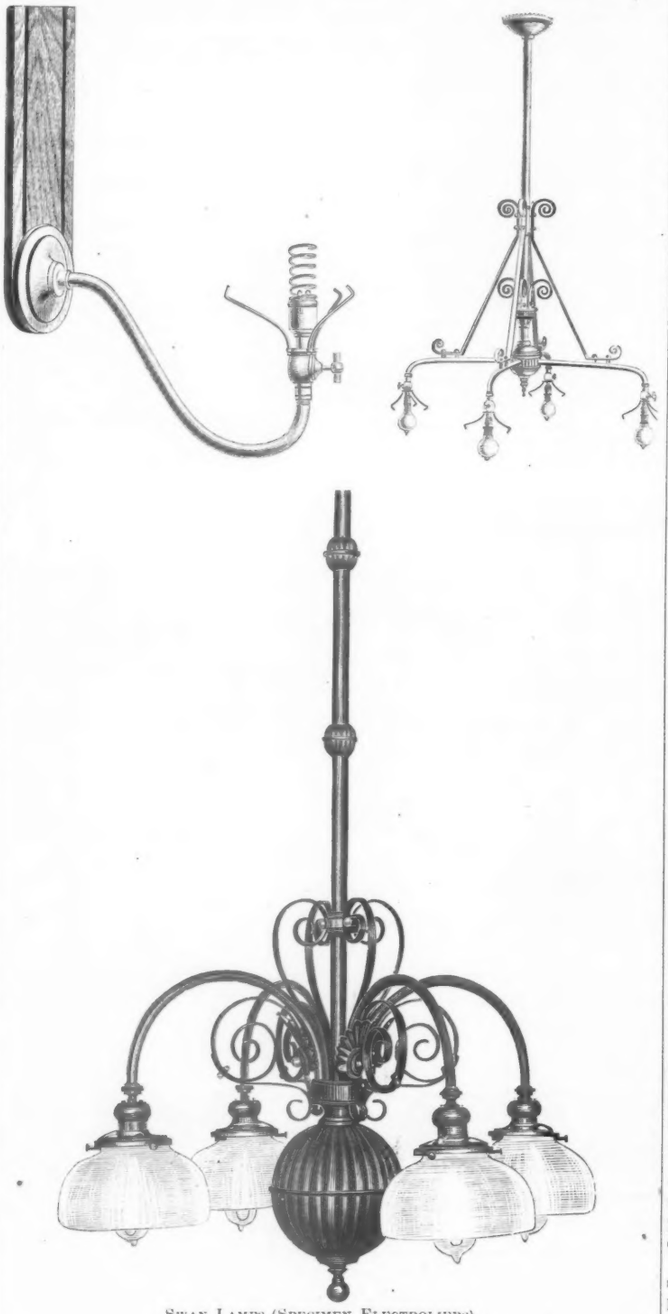
The Swan lamp can be adapted with small cost to existing gas fixtures, and when desired it can be used in connection with oil lamp fixtures. Special fixtures, electroliers, chandeliers, and brackets of various and elegant designs are furnished with the lamps when ordered.

The light is turned off or on by means of a key, or button, made of rubber, and each lamp is entirely independent of the others, which may be arranged in groups if desired. Chandeliers arranged for any number of lights, and from standard, or special designs, if required, are furnished by the company. These may be arranged so that one lamp or a series of lamps may be turned off or on at will.

Each lamp is provided with a safety attachment. In case of accident to the line by short circuiting, the circuit is instantly broken. The wires leading to the fittings are perfectly insulated in a fire-proof material, thereby absolutely preventing any danger from fire. These wires may be run between walls and floors and through partitions with perfect safety, or they may be enclosed in ornamental wood strips crossing the ceilings and easy of access.

There is no danger to property, life, or health in the use of the Swan lamp. The usual current supplied from secondary batteries gives no more shock than a toy battery. It is non-explosive.

The age demands an illuminant that offers a practical remedy for the many disadvantages and annoyances of gas. Without taking into account the many deaths and destructive fires resulting from the use of gas, there is involved in its use countless other baneful effects. An English writer says that "The evil effects of the heat of gas jets is augmented by the large amount of water produced by the flame. Sixty burners will produce two gallons of water per hour; hence in an evening many large shops filled with delicate goods will have nine gallons of water thrown into their atmosphere in the form of steam, to condense on any cool surface, as we often see it trickling down the windows in winter. But worse remains behind. The sulphur, always present in gas, burns into sulphurous vapor, which passes in the air to oil of vitriol, which is very destructive of health. The fumes from gas will indeed, in the long run, discolor every sort of fabric, rust metals, rot gutta percha, and reduce leather (as in the binding of books) to a scarcely coherent powder with a strongly acid taste.



SWAN LAMPS (SPECIMEN ELECTROLIERS).

The flaring and hissing, so well known and so troublesome where there are variable gas pressures; the disagreeable smells of half-burnt gas, and the consequent headaches and feeling of oppression so prevalent where gas is freely burned; the filling of the atmosphere with carbonic acid gas, and the destruction of valuable furnishings, are all obviated by the use of the silent, steady, bright, and clean Swan lamp. Those who are in the habit of reading and writing, and who prefer the badly-smelling oil lamp, to the flickering, flaring gas-burner, so hurtful to the eyesight, will welcome the healthful, agreeable substitution for both, of the Swan lamp.

Several hundred persons connected with electrical and manufacturing interests visited Willimantic, Conn., last fall, for the purpose of witnessing the first large installation of incandescence lights in connection with storage batteries. The Brush-Swan company had made arrangements with the Willimantic Thread Company to light their vast works with stored electricity. There were electricians present who had given their opinions orally and in print, while admitting that the storage battery had in it the germ of a great discovery, its economical use for every-day purposes was as yet a long way in the future. But the men who kept their eyes and ears open and put questions to the Brush representatives that hit the bull's-eye every time, were the cool, practical, economical mill owners and mill agents from adjacent States, who have been patiently waiting for years for some relief from gas illumination.

The company began to experiment with a Brush arc light in 1878. It did not long remain an experiment, for when they put up their big new mill (50,000 spindles, all on one floor), it was built especially for the arc lights, all the belting being run underneath the floor. They did not put in a single gas burner, to the great consternation of the local gas company, who had calculated on fully 1,500. Their action was followed by an almost immediate reduction in gas.

Last year the company put in a sixty-light Edison plant in the winding-room of No. 2 mill (the second largest) getting the power to run the dynamo from the mill engine. And right here they found that the Edison light was not going to answer them. Sometimes it is necessary to stop the entire machinery in the mill for a few minutes to make an adjustment. When the machinery stopped, the lights went out and the operatives were in total darkness until it was set in motion again. Last fall they put four Brush storage batteries on the floor of the carding-room of No. 2 mill, and began experimenting with more than 250 lamps. Their success was beyond their anticipation, for they found that they could put in six or eight batteries without an increase of power. The main offices, reading-rooms, library, president's office, and co-operative stores, besides the mill, are now lighted from the batteries already put in. They have thrown out 500 gas burners, all told.

They get their power from water that has heretofore run over the dam and been so much waste. Thus they get their light for simply the wear and tear of the machinery and the interest on the investment. By a calculation made two or three years ago it used to cost $13.80 an hour to furnish gas for No. 2 mill alone.

The loss of electrical energy in the batteries is said to be only from fifteen to twenty per cent.

The batteries were filled and the dynamos had ceased running for some time before it was dark enough to light the mill. The visitors were grouped about the queer-shaped boxes containing the lead and sulphuric acid watching the busy operatives at work. The superintendent stepped to the desk and touched a button, and two hundred shining little globes made the room as bright as day. The colors of the thread could be matched as well as in the sunlight. The lamps burned steady and unwavering, and the air was sweet and cool. So different from the hot, vitiated atmosphere of a large room heated by gas.

The electrician gave some interesting experiments of the way in which the lamps can be manipulated. He would start one, ten, twenty, forty, or even seventy, at a time, first in this corner and then in that. No running around with dangerous matches.

Everybody was pleased and impressed with the exhibition. There is a relief for the thousands of operatives who are compelled to do night-work in the foul air of the over-heated rooms in our great mills.

The following official report made by a select committee appointed by the Bridgeport, Conn., Board of Trade will be found to give many interesting details, and, since it was made by impartial judges, may be considered absolutely reliable.

TO THE BOARD OF TRADE OF THE CITY OF BRIDGEPORT.

Gentlemen—The undersigned having been appointed by your honorable body to examine into and report in regard to the subject of electric lighting, as exhibited at Willimantic, would respectfully report:

That on Wednesday, Oct. 3rd, we attended, accompanied by quite a number of citizens of Bridgeport, the exhibition at that place given by the Brush-Swan Electric Light Company in the mills of the world-renowned Willimantic Linen Company. * * * They require the arc light for certain

purposes of larger lighting outside the buildings and the incandescent light for lighting the fine machinery and the still more delicate fabric inside. In their office and reading rooms it is necessary to have a constant supply capable of instantaneous use, whether the dynamos be running or not, so that the storage system is brought into requisition. An opportunity of seeing the practical operation of making, storing and using electricity in both the arc and incandescent lights was thus afforded, and certainly no more beautiful form of artificial light was ever produced; steady, luminous, brilliant.

In a mill run by water-power the immense advantage of the storage system can be readily understood when it is remembered that at night, when the water is shut off from the factory wheels it runs over the dam, and thus much surplus power is wasted. If, instead of that it is set to work to produce the following day's or the following week's supply of electricity the power necessarily cost but little. The same thing is true to a less extent when a manufacturing company does not use, or need, all the power its engine is capable of producing. * * * The agents of the Brush-Swan Company furnished your committee with the following statement:

A No. 8 machine, their largest, required a 40-horse-power engine to properly run it. So run, it will furnish every twenty-four hours electricity for eighty arc lights of 1,200 candle power for six hours, and 1,400 incandescent lights, for four hours, and this same proportion continues; with less light you can have more hours, and with less hours more lights. Such a machine with thirty-five 40-light storage batteries, or seventy 20-lights with all the apparatus complete, put up and ready for lighting, costs about $26,800. To this is to be added the cost of the engines, boilers, &c. The expense of making a forty horse-power engine capable of running such a machine properly with coal at $4.00 per ton, is estimated to be less than $37.00 per day. Assuming then the cost of an engine, boiler, &c., put up ready for use, $3,500, the electric machine, including batteries, $26,800, the original outlay would be $40,300, exclusive of cost of real estate purchased or leased. These being obtained, by the daily expenditure of $37.00, eighty arc lights capable of burning six hours, and 1,400 incandescent lights, capable of burning four hours, are produced. If then, these lights can be sold at a price to reimburse the company for this daily expenditure and a fair interest on the plant, the investment would seem a paying one. As the ordinary price to-day received for an arc light in most places is at least sixty cents per night, this would seem probable. A great number of other electric light systems have been called to the attention of your committee by parties interested, but as they were especially appointed to attend the Willimantic exhibition, they have confined their report to the Brush-Swan system. In this connection, however, it would be proper to say that the legislature, some three years ago, incorporated a company to supply the city of Bridgeport with electric light; that company, it is understood, was duly organized, but has done but little more, preferring to wait for developments. Your committee have been informed that the parties interested in that project are willing that any citizens of Bridgeport desirous of investing money in the business of electric lighting should join them, or even take their places, if thereby any advantage might accrue to the city in the furnishing of better and cheaper light.

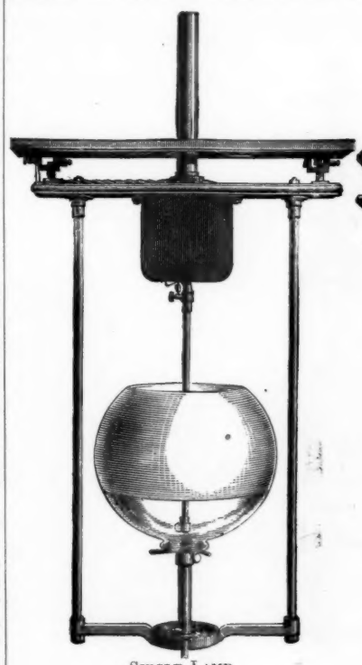
All of which is respectfully submitted.

DAVID M. READ,
HENRY H. ATWATER,
MORRIS W. SEYMOUR, } Committee.

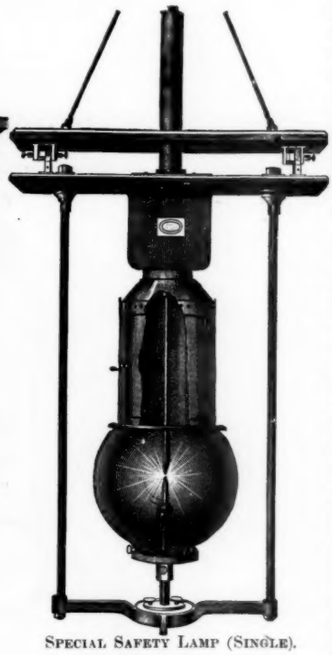
This much of the Brush-Swan incandescence system. In arc lighting, the Brush Company or rather its licensees recently established a great lighting plant in the City of Rochester, N. Y., in which the whole power required to light that city is gathered from the river that runs through its environs.

It was enterprising in this electrical company, to establish a large plant with the avowed purpose of lighting a city by the use of the energy running to waste within its boundaries. It showed that the Brush Company's lessees had confidence in their plant and in the assurances that had been made them by the parent company. That they did not over-estimate their ability nor the efficiency of their plant, is conclusively shown in the fact that their project has proved a success.

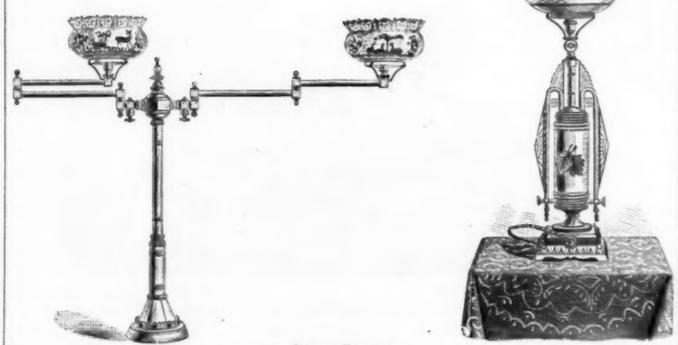
The works are located on the west bank of the Genesee River, at what is styled "the Lower Falls," within the City of Rochester, N. Y., and they derive their motive power from the waters of that river. They are intended for generating electricity for lighting purposes in the City of Rochester and vicinity. They consist of a brick superstructural building or house, 100 feet long and 50 feet wide, and one story high, resting upon and supported by substantial substructural walls and piers of stone and brick, of various heights and forms, and substantially based upon prepared foundations at various levels in the solid rock.



SINGLE LAMP.



SPECIAL SAFETY LAMP (SINGLE).



SWAN LAMPS.

The superstructure is spanned across its width, at the base of the roof, with nine trussed girders, which support the roof and the line shafting with its leading wooden-rimmed band wheel, 5 feet diameter by 4 feet 8 inch face, and 18 pairs of fast and loose wood-rimmed pulleys, 42 inch diameter by 13 inch face each, making 360 revolutions per minute, and connecting by 12-inch belts with 18 electro-dynamic machines arranged upon the floor near either side of the building, giving them 756 revolutions per minute, at an expense of 40 horse-power each, making a total of 720 horse-power, supporting 720 lights, equal to 40 lights per machine, or one light per horse-power. The magnitude of the lights is not stated.

The fast-and-loose pulleys which drive the dynamos were furnished by the Taper Sleeve Pulley Works, of Erie, Pa., and they are so constructed and arranged that by one single and gradual movement of a double-headed oscillating cam, in connection with a belt-shifter, the loose pulley, which hangs on a hollow, independent bearing, concentric with and surrounding the shaft without contact therewith, is thrown into gear and set in motion, so that as the cam is continuously moved forward through the extent of its parallel arc, which holds the loose pulley in gear, the belt is shifted on to it, when, by a little further movement of the cam, its inclined part at the rear end disengages the clutch, and the loose pulley, together with the belt and the actuated machines, cease moving and remain idle, until the cam is moved in the reverse direction, setting the idler in motion, shifting the belt into working position and setting the machine in motion, when, by the inclined part of the opposite end of the cam from that afore-mentioned, the clutch is disengaged and the idler is again at rest, out of contact with any of the running parts.

It is in contemplation to add nine more electric machines in this same building to be driven by the same power, should time and circumstance demand it, making 27 in all, producing 1,080 lights and requiring 1,080 horse-power. The power is to be obtained by the use of two Victor turbine water wheels, 20 inches in diameter, made by the Stilwell & Bierce Manufacturing Company, Dayton, Ohio. This wheel is noted for the extraordinary power developed by it, in proportion to its diameter, while at the same time the percentage of power, in proportion to water expended (according to tests made at the Holyoke testing flume), ranks it among the highest and best.

Another advantage possessed by this wheel is that its comparatively small diameter for a given power causes it to revolve so rapidly as to make a considerable saving in the cost of shafting and gearing.

The situation and surroundings of the water wheels and their appurtenances, in this case are, indeed, unique and extraordinary, and indicate a perspicacity of discernment, acuteness of conception, boldness of design and thoroughness of execution on the part of the projector that stamps him at once as eminently qualified to place and execute a work like this, environed as it is by great natural obstacles and serious practical difficulties. To make a proper place for the flume or forebay, an open recess or bay was cut into the upper rock bank about 32 feet horizontal depth, by 20 feet wide and 36 feet perpendicular depth, down to a level with the bottom of the head race. The bottom of this bay is about 45 feet below the floor of the superstructure, and extends under it about 28 feet.

From the bottom of the recess at its back side, is a shaft about 12 feet square, sunk perpendicularly into the rock to a depth of about 90 feet, to a point some four or five feet below the surface of the back water from the river below the falls, which are nearly 100 feet high, as will be seen by the cuts. From this shaft a culvert extending about 36 feet in height from the bottom of the shaft, is cut through the rock out to the river, as shown in cuts. Between the top of this opening or doorway, and the bottom of the race and forebay, is about 55 feet vertical thickness of rock. On the bottom of said recess in the rock, and partly over the shaft therein, is the flume, containing two U-shaped iron forebays, seven feet high, opening toward the head race, and from the bottom of which are suspended two iron stand pipes, 76 feet and 10 inches long by 42½ inches in diameter, their upper ends opening into the forebays to receive water to supply the wheels. At one side of each stand pipe, and connected thereto with a short cylindrical tube, is an iron wheel case, with a draft tube attached to its bottom, and extending some ten feet downward, and entering the back water.

Besides the support to the stand pipes by their connection with the iron forebays, they and the wheel cases are supported at their bottoms by iron beams. The turbines are placed in the wheel cases, and each one has about 58 feet of steel shafting, 3⅛ inches in diameter, coupled to and supported by bracket bearings projecting from the stand pipes. Each of said shafts has on it, near its top end, a spur pinion 21¾ inches in diameter by 17 inch face, 17 teeth, 4 inch pitch, machine dressed. These gear into a core spur wheel 69⅛ inches in diameter, having 54 wooden cogs, and which is hung on near the bottom of a steel countershaft 6 inches in diameter and 60 feet long, on which, near its top end, is a bevel wheel 88 inches in diameter, 18 inch face, 55 teeth, 5 inch pitch, gearing into a core bevel wheel, 99.6 in diameter, with 56 wooden cogs, 18 inches wide. This wheel is on a short, horizontal shaft, 6 inches in diameter, having on its further end, beneath the floor of the building, an iron spider carrying a wooden-rim band-wheel, 10 feet in diameter by 4 feet 8 inch face, carrying a rubber belt 4 feet 6 inches wide, by ¾ inch thick, which connects with the heretofore described five-foot leading band-wheel on the main line of shafting above, and drives them.

The turbines operate under 94 feet head of water, including the 10 foot draft tubes, and are estimated to make 582 revolutions per minute, and develop 572 H. P. each, which, combined, equals 1,144 horse-power. The counter upright shaft makes 183.22 revolutions per minute, the counter horizontal shaft, with the ten foot band-wheel, 179.95 revolutions per minute, the main line shaft about 359.9 revolutions per minute, and the electron-dyamos 755.79 revolutions per minute. By the Brush system of constructing machines it is possible to produce from a single machine a large number of lights in series in one circuit, say 65-2,000 C. P. lights, or even more.

This light, owing to its power and brilliancy, is especially adapted for use in large spaces, such as stores, factories, halls, parks, streets, harbors and light-houses. Lighting companies for introducing this light with a view to renting to individuals who have not the necessary power to produce it for themselves, have been organized in nearly all large cities of the United States, including New York, Albany, Buffalo, Niagara Falls, Boston, Philadelphia, Pittsburgh; Cleveland, Cincinnati, Akron, Middletown, and Toledo, Ohio; Baltimore, Indianapolis, Chicago, Aurora, and Ottawa, Ill.; Detroit, Grand Rapids and Alpena, Mich.; New Orleans, Denver, Salt Lake City, Ogden, San Francisco, Galveston, Topeka, Louisville, Butler, Mo.; St. Joseph, Fargo, La Crosse, Nashville, Chattanooga, Atlanta, Helena, Butte, Mont.; Savannah, Macon, Columbus, Memphis, Minneapolis, Fergus, Minn.; Evansville, Ind.; Cheyenne, Wyo.; Albuquerque, Silver City, Las Vegas, and many others.

In many of these cities contracts have been made to light the streets.

In public street lighting, the lamps may be turned on or off from the central station; thus a whole city may be lighted instantaneously. The lights in private residences or factories may be arranged so as to be controlled from one point, or each light may be independent of all others.

The number of electric-lighting companies is steadily increasing from day to day; a large amount of capital has already found in this new field a safe and remunerative investment, and the demand for the light is in excess of the ability of the companies to furnish it.

Many thousands of Brush arc lights are now in use in the United States, and nearly one hundred companies have already been formed to furnish the light as a legitimate business. It is estimated that the aggregate earnings of these lights the past year exceeded four millions dollars, and that there is a total capital of many millions of dollars employed in companies alone. All of these organizations under the parent company are steadily increasing their business, more especially in the larger cities and towns, and most of the stocks of these companies are either held at a considerable premium or not in the market at all.

The Brush lights used and operated by individuals and firms outside of lighting companies, in the United States, are divided about as follows:

Rolling mills, iron and steel works, machine shops, &c.	1,550
Woolen, cotton, linen, and silk factories,	2,000
Large stores	700
Parks, docks, summer resorts	500
Mines, smelting works	225
Lumber and saw-mills	200
Railroad companies	500
Hotels	300
Ninety-three steamboats, using	250
Factories and establishments of various kinds	2,600

The success of the Brush system has been no less marked abroad than at home. A large business has been transacted by the Anglo-American Brush Company of London, and its works and connections are of the most extensive character. The Admiralty, the War Department, the Committee of Council on Education, the Post-office, the Corporation of the City of London, the Great Western, the Great Eastern, and the Midland railways, and many other large corporations are among the users of the Brush light.

The excellence of the Brush system of electric lighting is acknowledged, not only for the brilliancy, steadiness, and uniformity of the light, but also for its great economy. Under the Brush system any number of arc lamps, from one to eighty, of 1,200 candle-power each, or sixty of 2,000 candle-power, or any number, from one to fifteen, each of 6,000 or greater candle-power, or a single light of 100,000 candle-power can be produced from a single dynamo machine. The conducting wires may be extended over circuits of many miles; thus from one center a large district can be economically lighted.

At the recent Paris Electrical Exhibition accurate measurements were made of the amount of light per horse-power produced by the various systems of lights there exhibited, and from this official report the following figures are extracted.

Actual amount of light produced for each horse-power of energy in the lamps:

	Candle Power.
Brush system	2,427
Cance "	1,983
Crompton "	1,890
Pilsen "	1,345
Gravier "	1,189
Serrin "	1,123

More lights can be run on one circuit.

Longer circuits can be used.

Wire of smaller size can be used to conduct the current.

Circuits may be of any length, even up to twenty or more miles, with a loss of less than the power of one arc light for every four miles.

Lights are steadier, whiter, and more powerful.

The works of the parent company, at Cleveland, are the largest of the kind in the world, and their business during last year was the largest in the history of the company.

No. 8 machine of 45 horse-power, will maintain 80 arc lights of 1,200 candle power each.

Or 65 arc lights of 2,000 candle-power—for an indefinite period.

Or 2,400 Swan incandescent lights of 16 candle-power, 4 hours per day, (by charging 24 hours, leaving sufficient time for rest of machinery,) being at the rate of 53⅓ lamps per horse-power per day.

Or 65 arc lights (2,000 candle-power) for 6 hours, and 1,840 Swan lights 4 hours per day.

Or 80 arc lights (1,200 candle-power,) for 6 hours, and 1,840 Swan lights 4 hours per day.

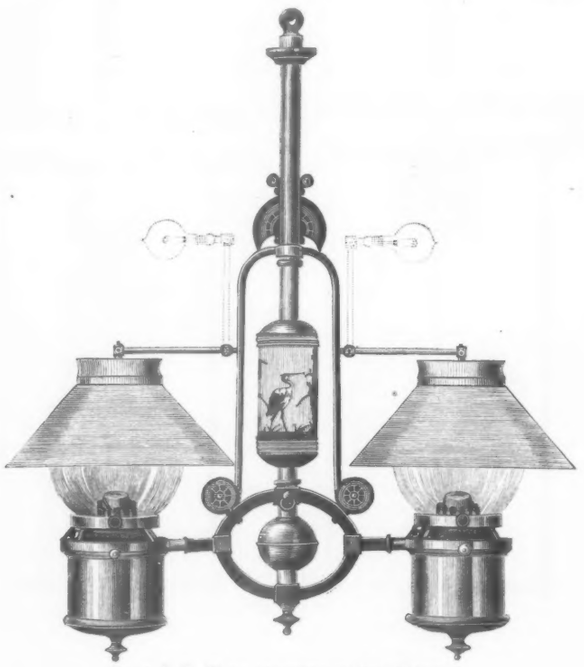
Or 65 arc lights (2,000 candle-power) for 10 hours, and 1,440 Swan lights 4 hours per day.

Or 80 arc lights (1,200 candle-power) for 10 hours, and 1,440 Swan lights 4 hours per day.

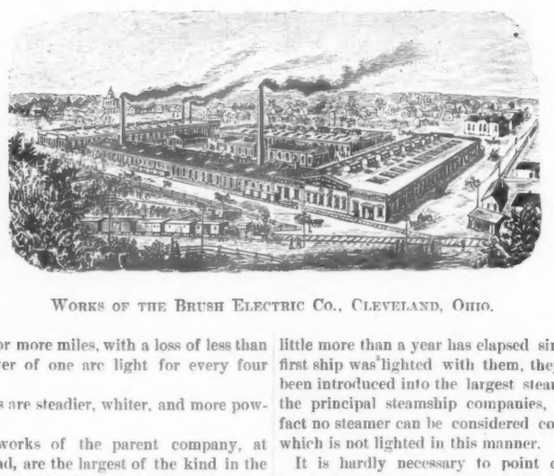
Or any desired proportion of number of lamps to time, within the range of these 80 and 65 arc lights and the 2,400 Swan lights per day.

The smaller machines will give like proportionate results.

The average of repairs, as shown by the apparatus longest in use, is much less than one per cent. per annum. on the cost of the plant; and the first machines manufactured by Mr. Brush are still in regular service.



Swan S. S. Lamp adjusted to Oil Fixtures.



Works of the Brush Electric Co., Cleveland, Ohio.

SWAN LIGHT ON SHIPS.

The introduction of the Swan lamp into large steamships as a means of illumination has proven so very successful that, although little more than a year has elapsed since the first ship was lighted with them, they have been introduced into the largest steamers of the principal steamship companies, and in fact no steamer can be considered complete which is not lighted in this manner.

It is hardly necessary to point out the great advantages this means of illumination possesses over the oil lamps generally used. With the Swan lamps a pleasant, soft white light is obtained, with this great benefit, that there is none of the heat and smell which are so specially objectionable in the cabins and saloons of steamers.

The Cunard Company evidently believe in the Swan lamp as a means of lighting the saloons and interiors of their vessels; several of them being now fitted up with Swan incandescent lamps. The latest addition to the fleet, the Pavonia, is lighted throughout with Swan incandescent lamps, each stateroom having one of these lamps, which can be turned on or off at the pleasure of the occupant.

After an extended trial of the electric light on board the Alaska, orders have been given for a complete installation of 300 Swan lamps in the ship, every one of the passengers' and officers' quarters being lighted by them to the entire exclusion of oil and candles. Very special attention is paid to the illumination of the engine-room. There are three lamps in the screw-shaft alley, and thirteen beside the gauge glasses of the boilers. Lamp sockets are fitted near various parts of the engines that require occasional attention, such as the glands, and the men are provided with loose lamps in very strong globes, and of such a size that they can be carried in a jacket-pocket, and slipped into the socket when required.

A steel paddle steamer called the Lonsdale has just been built at Greenock, 200 feet long, 25 feet beam and 10 feet hold, and intended to be very fast. She is being fitted throughout with incandescent lamps by the Swan Electric Lighting Co.

The Invicta, a new steamer recently built for the London, Chatham and Dover Railway Company, is lighted by means of Swan incandescent lamps in the saloons, engine-room and other parts between decks.

The steamship Antonia Lopez, built for the Transatlantic Company of Barcelona, has been fitted with Swan incandescent lamps, seventy of which are distributed throughout the saloons and passages.

PARTIAL LIST OF OCEAN STEAMERS FITTED WITH THE SWAN LAMP.

S. S. City of Chicago S. S. City of Richmond	Inman Line.
S. S. Servia S. S. Aurania S. S. Cephalonia S. S. Pavonia	Cunard Line.
S. S. Normandie S. S. St. Laurent S. S. Amerique S. S. France	Compagnie General Transatlantique.
S. S. Arabic S. S. Doric S. S. Coptic S. S. Ionic	White Star Line.
S. S. Chimborazo S. S. Orient S. S. Cotopaxi S. S. Austral	Orient Line.
S. S. City of Rome	Anchor Line.
S. S. Alaska	Guion Line.
S. S. Goorkha S. S. Rewa	British India Steam Navigation Co.
S. S. Manapouri S. S. Wairarapa	Union Steamship Co. of New Zealand.
S. S. Antonio Lopez	Compania Transatlantica.
S. S. Invicta	L. C. and D. Railway Co.
S. S. Lonsdale	Captain James Deane.
S. S. Faraday	Messrs. Siemens Bros.

A New Electric Motor.

A PUBLIC EXHIBITION OF THE MOTOR SOON TO BE MADE.

If the expectations of a number of Chicago gentlemen are realized it will not be long until the citizens of that city are carried down town by means of street cars run by electricity. Hearing that a gentleman living on the south side was making experiments with a new electric motor, a reporter called at his house. At first he seemed disinclined to talk, saying that the enterprise was hardly matured enough to be presented to the public; but at length, after some persuasion, the visitor was escorted from the front to the back parlor. There, on a long extension table, was a street car weighing, it was explained, 150 pounds. It rested on a track which was laid on the table. Two parallel seats extended from either side of the front part of the car to the center. Between these seats was an electric battery, which, in the car proposed to be run on the streets, will be replaced by a set of "storage cells." At the rear of the car was the motor, which is composed of magnets of peculiar construction.

"This new electric motor," says the gentleman, "does not use the attractive surface of the ends of a magnet alone, but also the

attractive surface of the side or sides of the elongated poles of the horseshoe magnet, as the inventor has ingeniously constructed them, and upon which letters patent have been granted.

We therefore secure the attractive power of many magnets, as with this improvement a stroke of many inches, and even feet, in length can be obtained, and at the same time no more electricity is used than in obtaining the two-inch stroke of the ordinary end magnet. Now understand," continued the professor, "that this is only a grip-car, and is intended to pull several street cars."

"Very good; but will it go?"

For answer the professor moved a little brass switch lever, the current of electricity found its way into the motor, the car moved with swiftness along the track, the professor rubbed his hands gleefully, and the reporter was satisfied that the model before him at least could do the work. By another turn of the switch the car glided backward. Again and again the grip was sent flying up and down the track.

"I have had a number of electricians here," the professor went on to say, "who would not believe that this invention was practicable until they saw it operate—in fact when it was first brought to my notice by the inventor I was a disbeliever, but after testing it thoroughly I am satisfied that it is a success. The motor takes up but little space, is almost noiseless in its operation, and is run without expert attendance, and it is only necessary to start it, and stop it, and regulate its operation by turning a switch. It runs with but little friction, as the gearing is of the simplest kind, and there is no heat, smoke, smell, or waste. Any intelligent driver can learn to handle it in a day. For propelling street cars no change of tracks or carriages is necessary. To the revolving shaft of the motor a gear-wheel is fastened which meshes into corresponding gearing on the rear axle for propelling the car. The car has the proportionate power of three horses, and a reserve of three additional for heavy loads and inclines, and this additional power can be supplied at the will of the driver by simply moving a switch placed on a table, back of which he stands. An ingenious starting device has been invented which is controlled by the driver. With his foot on the long arm of a lever he turns the wheels as easily as a boy propels a wheelbarrow by raising the handles."

"Do you expect to give a practical and public exhibition of the motor soon?" was then asked him.

"Yes. We are now building a full-sized car, storage cells have been ordered, and inside of a month our car will be run over one of the street railway lines of the city."

AMERICAN ENTERPRISE.

A GREAT TRANSACTION COMPLETED — THE AMERICAN ELECTRIC AND ILLUMINATING COMPANY SECURES A VIRTUAL MONOPOLY OF ELECTRIC LIGHTING IN THE DOMINION OF CANADA.

[Correspondence of the ELECTRICAL REVIEW]

MONTREAL, CANADA, Jan. 12, 1884.

The special sensation of the season in electrical and financial circles has been the sale of the entire business and property, visible and invisible, of the Thomson & Houston Electric Light Company of Canada, to the American Electric and Illuminating Company of Boston.

It is hardly possible to overestimate the importance of this transaction. The virtual control of electric lighting for the entire Dominion is thereby secured by the enterprise of the Boston Company. The Thomson & Houston Company of this city, which, like the unfaithful servant in the parable, has hid its talent in a napkin, is now compelled to yield it up to a corporation which has the skill, the nerve, and the ability to put it to use, and make it yield a hundred-fold returns.

This Thomson & Houston Electric Light Company, which secured a most liberal and comprehensive charter from the Dominion Parliament, authorizing it to carry on the lighting business anywhere in the Dominion, with a monopoly of the Thomson-Houston system, has established a factory on Dowd Street in this city, capable of turning out about one dynamo per day, and all the lamps and supplies needed to establish complete lighting plants. Here quite a large number of dynamos have been made, and are on hand, and also several hundred lamps and the other materials. It has also established a very small lighting business in this city, and shipped small plants to Quebec and St. John, N. B. And that is all it has done in about a year. Having admirable facilities for manufacturing, an almost boundless field for lighting, and no opposition to speak of, it has been contented to sit down and wait for business to seek it out. It is safe to say that the course of the new owners of the property will be very different.

Let us see what the American Electric and Illuminating Company secures by its purchase.

First. The ownership for the entire Dominion of Canada of the patents and rights to all of Professor Thomson's and E. J. Houston's electrical inventions already perfected, or to be perfected during the next five years.

Second. The sole right to manufacture the Thomson-Houston apparatus, and to use the system for lighting within the Dominion.

Third. A factory completely equipped with the most improved machinery and tools for manufacturing every portion of the electric lighting plant; all the tools and machinery being made to order by the Pratt & Whitney Machine Works at Hartford, Connecticut.

Fourth. Some twenty dynamos and 325 lamps, with other mechanism, wires, carbons, and a large lot of material ready to be manufactured.

Fifth. A small amount of lighting business, which only requires energy and enterprise to develop into something handsome.

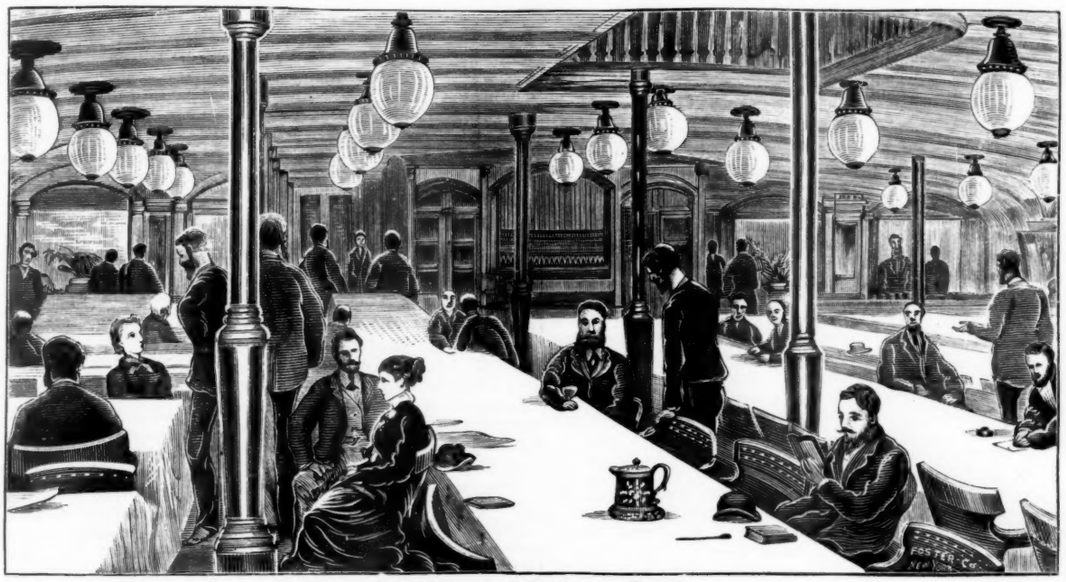
Canada ought to be a good field for electric lighting. There are many large and thriving cities and towns, and sufficient business and wealth to promise ample support for such an enterprise. But hitherto American electric light companies have been virtually debarred from invading the Dominion by the tariff duties of 35 per cent. on the importation of machines, and this, added to the high cost of the machines themselves in the States, has been almost prohibitive. In the case of the American Electric and Illuminating Company this obstacle will no longer be interposed, for it can manufacture all its own plant for Canada here in Montreal, as well and as cheaply as it can be done anywhere. As an illustration of the quality of the work turned out here, under the supervision of Professor William Thomson, brother of the inventor, and electrician of the company, I may mention that I saw a new 25-light dynamo, just finished at the Dowd Street shops, run 36 lights on the factory circuit, and run them all up to the full standard of brightness. In all the details of manufacture, the machines and lamps made here are fully the equals of those turned out by the Thomson-Houston Electric Company, at Lynn, Mass.

Another feature which will go to strengthen the position of the American Company here, and improve the mechanical working of its system, is an alliance just made between the company and Armington & Sims, of Providence, R. I. The Armington & Sims' engines, which Edison endorses as the best engines for electric lighting purposes, which the American Company uses in the States, will be adopted for exclusive use in Canada, and the Dominion patents of Armington & Sims will either be transferred to the American Company, or a new corporation formed to build the engines.

The business here and throughout the Dominion will be managed by the Boston Company, one or more of whose officers and directors will give their personal care and supervision to it. It will be known as the Canadian Branch of the American Electric and Illuminating Co., and a resident manager will—under the supervision above described—attend to the development of the lighting business wherever advisable in the Dominion, and also to pushing the work of manufacturing the plants and supplies necessary to equip and operate the stations in the several cities of Canada.

This whole transaction has been carried through in the business-like style for which President Goff of the American Company is famous, and its results will not only advance electric lighting interests in the Dominion, but will prove vastly profitable to the American Electric and Illuminating Company.

SIDNEY.



SWAN LIGHT ON S. S. "CITY OF ROME."

Brush Electric Association of St. Louis—Arc and Incandescent Lighting—The Wonderful Electric Storage Battery.

St. Louis has taken a very prominent position in the introduction of electricity as a means of lighting. Some three years since some of its citizens secured the exclusive agency of the Brush Electric Company, of Cleveland, for several States, viz.: Missouri, Kansas, Texas, Arkansas, Louisiana, Mississippi, Tennessee, Kentucky, Southern Illinois, Georgia, Alabama and Florida. They organized a corporation under the laws of this State called the Brush Electric Association, and have effected sales of Brush electric lighting apparatus in every one of the States above named.

The Brush Electric Association has, through its agents, organized lighting companies in New Orleans, Galveston, Little Rock, Topeka, Memphis, Louisville, Nashville, Macon, Ga., Savannah, Chattanooga, Columbus, all of which companies are now using Brush apparatus sold to them by the St. Louis corporation. In addition large sales have been made of apparatus to hotels, stores and manufacturing concerns throughout the States named, and there are to-day on our western rivers some fifty steamers using the Brush light.

The association is now prepared to furnish the storage battery recently patented by Mr. Brush, which, in connection with his other apparatus and the Swan lamp, affords the cheapest system of incandescent lighting yet presented to the public.

A battery with Swan lamps has been in successful operation during the last month at the store of the Wm. Barr dry goods company, corner of Sixth and Olive streets in St. Louis.

The electric lighting plant employed by R. H. White & Company, Boston, will be increased from 700 to 1,300 lamps at once.

The New Bedford Electric Lighting Company has offered to put electric lights in the large room of the Public Library for a month on trial free.

Telephonic News

The Iowa Union Telegraph and Telephone Company.

The above-named company, under the efficient management of its enterprising General Manager, Mr. W. A. Leary, has been making very rapid progress during the last twelve months in the way of increasing its toll line mileage and number of exchange subscribers.

The company now has two thousand four hundred miles of toll lines in operation, the earnings from which are assuming a very handsome proportion of the total earnings.

Some idea of the amount of work in the way of construction which has been done by the company during the last year, can be gained when it is known that some seventy thousand (70,000) poles were put in the ground during that time.

Among the latest exchanges opened up are Bedford, Perry, Angus, and Bloomfield.

The first named of these is a smart and growing town of three thousand people, and is the county capital of Taylor county. It is on the Creston branch, Iowa Division, of the Chicago, Burlington and Quincy Railroad, opened up on December 31st, with forty-one subscribers, and is certainly a promising telephone town.

The exchange is fitted up with the latest improved Western Electric Switchboards and Post magneto bells.

On the same date (December 31st), Perry, a town of about the same number of inhabitants, situated on the Des Moines and Ft. Dodge and Chicago and Council Bluffs Division, Chicago, Milwaukee & St. Paul Railroad, was opened up as a telephone exchange, with forty-three subscribers to begin with. This number of subscribers will soon be very materially increased, judging by present indications.

Angus is a town of two thousand inhabitants, about four or five miles from Perry, on the Des Moines & Ft. Dodge and Minneapolis and St. Louis Railroads. Twenty-five subscribers were put into this town on the 3d inst., and the town is good for more.

Bloomfield, two thousand inhabitants, is the county seat of Davis county, on the Chicago, Burlington and Kansas City, and Northern Division, Wabash, St. Louis and Pacific Railroads, and is to be opened on the 7th of January with about fifty subscribers.

These are only a few of the very latest exchanges opened up. Enough have been opened up during 1883 to make the present number of subscribers of the Iowa Union Telegraph and Telephone Company exceed three thousand at the present time.

The company is evidently in a splendid condition, and capable of very large developments in a paying way.

Iowa is generally looked upon as good telephone territory—the number of telephones in proportion to the number of inhabitants in the different towns being quite large.

The Iowa Union Company holds its annual meeting of stockholders on the 7th of January, and its Board of Directors hold their meeting on the 9th of the present month, for the purpose of electing officers for the ensuing year.

Rapid Extension of the Nebraska Telephone System.

The Nebraska Telephone Company have issued a new directory, which is numbered the ninth of their lists, and indicates the rapid extension of the system, rendering frequent issues necessary in addition to the supplements.

The new directory contains over 1,500 names. The company has over 1,300 telephones in list, owns seventeen exchanges, and has built 420 miles of line. Omaha people can now talk directly with 61 different towns in Nebraska and Iowa.

The list issued by the Nebraska Company is far superior in form and typographical style to those issued by cities of equal size or larger, and shows the thoroughness and enterprise of the company in the details of its business.

By the purchase of the rights of Bell and Blake to patent their telephone apparatus in Mexico, the Mexican Central Telephone Company secures the advantage of purchasing instruments manufactured by the American Bell Telephone Company at very favorable rates, and, though it purchases them nominally through the Mexican Telephone Company, its contract with the latter is such that the so-called "sub-company" will apparently have the best end of the bargain. This contract has two years longer to run, while that of the Mexican with the American Bell expires in February. The Mexican Central controls the States of Guanajuato, San Luis Potosi, Zacatecas, Queretaro and Aguas Collientes, containing about twenty cities large enough to enjoy telephone facilities, and five of 50,000 population or over. Its territory is opened by the lines of the Mexican Central, Mexican National, and Mexican Oriental railways, and is considered the best in the republic.

The Inter-Continental Telephone Company had 176 subscribers in Caraccas, S. A., up to Nov. 1, which pay $8.75 per month each.

The Tropical Telephone Company has just shipped 375 sets of instruments to Buenos Ayres, making 2,600 sets shipped by this company since May 1 to its South and Central American field.

Presentation to a Telephone Superintendent.

Mr. Walter D. McKinney, for the past three years connected with the Telephone Dispatch Company at Boston—the last year as superintendent—was on Tuesday evening presented with an elegant gold watch, of the E. Howard Company make, the gift of some of his many friends connected with the company.

Mr. McKinney has resigned his position with the Boston company to accept the superintendency of the Washington (D. C.) Exchange, and we are confident that he will prove a valuable acquisition to General Manager Lytle's force.

He leaves Boston with the best wishes for his success in his new undertaking.

We note the following, in one of our Portland (Me.) exchanges, which shows how the excellent service at that place is appreciated:

CARD OF THANKS.—The operating force of the telephone exchange were very happily surprised recently by a cash New Year's present, from the leading business firms of Portland, of $42.25—which gives each operator several dollars.

The subscriber desires, in behalf of the operators to heartily thank Messrs. Brown & Josselyn, and thirty-one other firms for this generous gift.

The operators are working hard to serve and please the patrons of this company, and will fully appreciate such kindly feelings.

Very respectfully,
I. H. FARNHAM,
Superintendent Telephone Company.

Telephone News from the South-West.

Editor of Electrical Review:

AUSTIN, TEXAS, Jan. 5, 1884.

DEAR SIR:—Telephonic progress in Arkansas and Texas has been so rapid and diversified within the past six months that it has been difficult to obtain complete statistics; but I have been recently favored with a number of items that I am satisfied will prove of interest to your readers.

On the 1st of June, 1883, there were some eighteen exchanges in the two States, and about 75 miles of extra territorial line.

There were at that time about 2,500 subscribers in connection.

I am told that a gain of 1,000 within twelve months was considered at that time a very flattering prospect, but to-day, after the expiration of only six months, the total number of connections has reached 3,600, showing a net gain of 1,100.

The result is, of course, surprising to those who have witnessed the slower progress of Exchanges in the older States.

Among the noticeable features of this advance it is worthy of note that some 1,200 miles of extra territorial line have been added to the plant of the old South-Western.

This comprises some of the very cream of the towns in Texas and in Arkansas.

The income from all sources, I am assured has quite doubled itself within the same period, and with the liberal allowance for construction purposes, is advancing at the rate of $1,500 per month.

The Exchanges so far completed are:

Fort Smith, Ark.,	Helena, Ark.,
Little Rock, Ark.,	Hot Springs, Ark.,
Jefferson, Texas,	Texarkana, Kan.,
Paris, "	Marshall, Texas,
Sherman, "	Denison, "
Greenville, "	McKinney, "
Colorado City, Texas,	Fort Worth, "
Gainesville, "	El Paso, "

Which comprises the International Exchange:

San Antonio, Texas,	Austin, Texas,
Waco, "	Belton, "
Lampasas, "	Houston, "
Galveston, "	Palestine, "
Brenham, "	Longview, "
Corsicana, "	Terrell, "
Waxahachie, "	Cleburne, "
Dallas, "	Brownsville, "

In course of construction.

Pine Bluff, Ark.,	Eagle Pass, Texas,
Lerado, Texas,	Alvarado, "
Weatherford, Texas.	

There are possibly forty towns in the State yet untouched that will carry from 30 to 75 subscribers each, but they are being rapidly worked up, and will soon rank among the stars in the South-Western firmament.

It is the intention of the company, as stated to me, to connect all these towns extra-territorially, and in fact the field for extra territorial construction upon a profitable basis is practically unlimited.

It appears that these territorial connections are wonderfully beneficial to small exchanges, in that it renders them cohesive and almost essential to the success of all kinds of business under the new order of communication which the telephone has brought about.

The majority of these long lines work remarkably well.

One purchase from the Government, connecting San Antonio and Eagle Pass, 168 miles apart, works remarkably clear and distinct, notwithstanding the fact that eight stations are on the same circuit.

The most of this work is done in the way of written messages, and controls pretty much the entire business between the points mentioned, notwithstanding the fact that some of them have telegraphic connections with the great systems of the State.

A recent happy innovation is the assignment of one manager to two or three small stations, which, being connected extra-territorially, renders the work of supervision remarkably easy and economical.

Among the curiosities of the telephone statistics of Texas, might be mentioned the connection of Matamoras and Brownsville, on the opposite sides of the Rio Grande, by 600 ft. 75 wire submarine *cable* of Western electric manufacture, which gives the most satisfactory results.

San Antonio, Tex., with a population somewhat less than that of Galveston, is the largest exchange in the State.

Galveston and Houston, 53 miles apart, in addition to several steel wires, are connected by a No. 14 hard drawer copper of the Bridgeport Brass Company, over which the slightest whisper can be heard, notwithstanding the fact that it is stretched on piling through three miles of the Galveston Bay, which is frequently subject to dense and impenetrable fogs.

Dallas is perhaps the greatest center for extra-territorial connections in the whole South, and the system is perfected to give satisfaction to the most fastidious, but for the fact that an excessive patronage frequently renders long waits a trying necessity.

Additional facilities, however, are being rapidly provided, and will eventually do away with this source of annoyance.

One line, fifty odd miles in length, is worked both telegraphically and telephonically, at intervals, and that without occasion for cutting off the battery currents, which do not seem to interfere in any measure with successful conversation.

San Antonio will soon boast of a two mile line of 50 ft. poles, with 100 wires, none of which are to be connected until the whole route is perfectly adjusted. It is intended that crosses will be out of the question on that line.

Among the incidents of reconstruction during the last few months, it may be stated that Hot Springs, Ark., has been entirely rebuilt, and is growing nicely.

Houston, Texas, which was originally part of the Western Union, is now in splendid shape.

Austin, Texas, has been completely overhauled, and is giving excellent satisfaction.

Dallas, Tex., will soon rank among the best of the Texas exchanges, and as for the new ones, it is not believed that the work for taste and substantiality can be excelled anywhere in the United States.

So much for the Southwestern. X.

Does the Direction or Route of a Line Increase or Decrease its Resistance?

Editor Electrical Review:

BOSTON, January 5, 1884.

I am always interested in the spicy letters of your Kansas City correspondent, and invariably read them.

I notice in Bi-Polar's letter of December 20th, published in the REVIEW of Jan. 3d, 1884, a statement regarding the galvanometrical test of the lines between Kansas City and Topeka and St. Joseph. I am pleased to learn that Gen. Supt. Smith recognizes the necessity for the testing of telephone lines. Your correspondent, after describing the good condition of the Topeka line, goes on to say: "The line to St. Joseph failed to show up so well, *though running north and south*—a direction that some imagine permits a line to work better than when running east and west." "This line is also 70 miles in length, but the test showed that it possessed a resistance equal to 177 miles, etc."

Referring to the above paragraph, I may state that it is an established fact, at least here in the East, that lines running north and south do work easier, and are on the average much quieter than lines of the same length running east and west.

I ascribe this phenomenon, which I have repeatedly verified in actual experience, to the fact that in the former case the lines run parallel to the magnetic lines of the force of the earth, while east and west telephone lines cross the said lines of force, and consequently each time they vibrate, either from stress of the wind or from any other reason, a magneto current is generated in them, producing a noise in the receiving instrument.

But it is also obvious that this can have no effect in determining the resistance of any line, as your correspondent seems to think, since resistance is always determined in electric wires, such as the length and size of line wire, bad joints, loose screwposts, bad earth, etc.

In the case under consideration, the greater resistance was, of course, caused by the interposed section of smaller wire, as intimated by Bi-Polar.

The fact that I desire to point out is, that although the direction or route of a given line does affect its working, it has no effect upon the line itself, and consequently has no effect either to increase or decrease its resistance,

THOS. D. LOCKWOOD.

Telephonic Progress Made in Nashville.

On account of the rapid growth of the service in Nashville, two switch-boards have become insufficient for the prompt answering of all calls. The exchange is consequently putting up another switch-board of the latest improved style, which will permit the use of four more operators, as well as accommodate forty-five additional pairs of cords. When this board is completed, which will probably be in about two weeks, 250 subscribers can talk at one time. It can readily be seen that the pressure upon the service will then be much lessened. However, subscribers now rarely have to wait nearly as long as the patrons of banks or business houses to be waited upon.

No estimate has yet been made of the average number of calls answered in one day, but not long since the answer "Busy, now," was returned to 900 subscribers in one day.

Where there is a fire-alarm as many as seventy-five subscribers usually call at the same time to know where it is, and all other particulars. A few days ago, a residence caught, and the lady of the house called excitedly through the telephone to give her the engine house. She did not say which one, and the wrong one was called, causing considerable confusion. The lady's husband was at first inclined to complain of the Exchange, but was shown that the mistake was at home. To fully appreciate the value of the telephone service, one has but to be deprived of its advantages for one day. A manufacturer whose circuit was temporarily out of repair told Mr. Baker that he lost more money in orders during one day than the annual rental of the instrument amounted to.

Of the 860 telephones now in use in Nashville, about 150 are in residences, and the remainder in offices and stores. The number of attorneys and physicians who are telephone subscribers are about equal—thirty-eight of each. The new telephone directory, which will be out next week, not only contains alphabetical lists of all subscribers, and telephone numbers in Nashville and other towns in the circuit, but has the various professions and kinds of business classified, with the names of the firms, etc., in alphabetical order.

There are now in use about 860 telephones in the city of Nashville, while a year ago there were but 150. This growth has exceeded the most sanguine expectations of the management, who are beginning to think how they will be able to accommodate a probable large increase All the wires in each cable leading to the central office and every pin on the pole routes are now occupied, so that until the new cables ordered some weeks since are added, no new subscribers can be connected. There are now a large number of unfilled orders for telephones in the office. A 100 wire submarine cable has been ordered for Edgefield in addition to the 50-wire cable now in use.

In Memphis there are now only about 580 telephone subscribers. A year ago there were 375.

Mr. Marrs, formerly superintendent of the Nashville Exchange, is now in charge of the New Orleans Exchange, where the number of subscribers is only 900—very little in excess of the number used in Nashville, a city with about one-fourth as many inhabitants. However, with the new aparatus and increased efficiency of the service in New Orleans, the company hopes to get as many as 2,000 subscribers.

The territory of the Cumberland Telephone Exchange, of which Nashville is headquarters, includes all of the State of Tennessee west of the Cincinnati Southern Railroad, eight counties in Indiana (including Evansville), six in Illinois and five in Kentucky. The number of subscribers in this entire circuit is now about 2,500, against 1,998 last June.

Two expert operators will be taken from the Evansville Exchange to Nashville, where the demand is greater.

The rental price of telephones to subscribers in Nashville still remains the same—$5 per month in business houses, and $4 per month in private residences. Still, the advantages now are much greater than formerly, as the number of subscribers has so greatly increased.

There are now thirty-five towns connected by telephone with Nashville.

The Warner Furnace and Lyle Station, near by, was connected last week. Contracts are also out for a new line direct to Shelbyville, taking in Nolensville, Collinsville, Triune and Englesville, a distance of fifty-five miles. When this line is complete lines will be run from Shelbyville to Wartrace, Tullahoma and Lynchburg.

Only one expert operator is required in the Nashville office after 10 o'clock at night, and this position is filled by Mr. Albert Garret, whose efficiency and uniform courtesy are recognized by all those who have to use their telephones, while the majority of the good people of Nashville are wrapt in slumber.

Mr. Frank B. Knight, special agent of the American Bell Telephone Company, has just concluded an arrangement with the Palmer Wire Company whereby he will act as the general agent of that company, with headquarters in New York City. This unexpected change takes from the telephone field proper one of its most active and deservedly popular men. We consider it quite fortunate that in this arrangement, however, his telephone friends will not entirely lose sight of him, but that it may be considered but a transfer to an auxiliary field to the one in which he has been identified so long. His extensive acquaintance among the telegraph, telephone and electric light people will enable him to continue the pleasant business relations with them which he has so long enjoyed. We join with all our most hearty good wishes for his success, which we know his untiring energy and ability will bring him. The following circular he has recently issued, which is herewith appended, speaks for itself:

OFFICE PALMER WIRE CO.,)
NEW YORK, Jan. 7, 1884.)

I take this method of informing my friends that I have resigned my position as special agent of the American Bell Telephone Company, and shall, on February 15th, assume the general agency of the Palmer Wire Company, with an office at 20 Cliff Street, New York City.

The Palmer Wire Company are large manufacturers of iron and steel wire, which is unsurpassed in quality of material, finish and conductivity.

If you are anticipating placing any orders for wire, I trust you may find it convenient to wait until I can call on you. Perfect satisfaction is guaranteed on all wire shipped by us. Correspondence solicited.

FRANK B. KNIGHT.

Storm Sounds in the Telephone.

A Belgian has lately studied the phenomena in a telephone during a thunderstorm which occurred at Brussels on June 30. The line was provided with a proper lightning protector, and there was therefore no personal danger. During the height of the storm he heard a continuous noise in the instrument, which he compared to the sound of frying. From time to time it grew louder; sometimes there would be a little popping sound, like a bubble bursting, and sometimes the series of crackling noises which attend the fall of a drop of grease on a red-hot plate. This latter noise came abruptly and loud with each flash of lightning, and seemed to precede it. The observer noticed that his ear heard this sound before his eye perceived the flash. The same noises were produced when there was no flash, but then they were less loud. These sounds prove the existence of currents of electricity in the telephone wires during a storm, and the inference is that telephone lines may be a source of safety to a city, since they may help to discharge the lightning. But they also show that a proper lightning protector is necessary to each instrument.

The Sunset Telephone Company, of California, have just laid a seven-conductor cable to Oakland, three miles in length, which is working very satisfactorily. The business of the Sunset Company seems to be very good; during the past two months large gains in subscribers are reported, and four new exchanges opened. They will build several important extra territorial lines during ensuing year. This company control about all the territory on the Pacific coast, outside of San Francisco.

Boston's Telephone System Destroyed by Fire.

BOSTON, January 12.—Owing to a fire this morning, on the roof of the building on Pearl street, occupied by the New England Telephone and Telegraph Company, this city is entirely bereft of Telephone service, and will remain so to a great extent till the 17th inst. The fire started in the cupola, through which runs the insulated wires that connect with the three thousand instruments throughout the city. These wires were destroyed, and many of the costly exchange boards in the exchange room below were made useless by reason of the destruction of the electro-magnets which control the drops. The whole system will, therefore, have to be renewed. The loss to the telephone company, including estimated damage from interruptions to business, will reach $8,000, which, with loss on the building, makes a total of $11,000.

The controversy long existing between the American Bell Telephone Company and the New England Electric Light Company has been settled by arbitration. Colonel C. F. Wood, late of the Western Union Telegraph Company, acting as arbiter. The result was satisfactory to both parties.

General Superintendent Keller and Colonel Roots have recently purchased the entire property of the Wilson Sewing Machine Company, at Wallingford, Conn., and are now turning out several car-loads of machines every day. This new adventure, together with their Western telephone and other interests, will preclude them from taking the trip to Europe, and the vacation so well earned by them.

There seems to be a revival of interest in the subject of a Government postal telegraph, and several of our Representatives have recently made set speeches on the subject.

Revenue of the Telegraph Service in England.

The receipts for the telegraph service from the 1st of April to the 22d of December, 1883–4, has been £1,280,000, against £1,240,000 in the corresponding period of the previous year. The estimate for the year is £1,750,000.

The Mexican Central Telegraph and Telephone Company show a gain of 23 subscribers in November, an increase of 1,400 calls at central office, and net profits of exchanges $206.09.

The Postal Telegraph Company has been bragging recently very loudly about the volume of their new Chicago business, and to offset the effect of such statements the Western Union has come out with a statement, showing that the W. U. business during the last 121 days of 1883 increased at the rate of $500 per day.

The Bankers' and Merchants' Telegraph Company intend to extend their lines to Pottsville at an early day.

A submarine cable has just been successfully laid from Cadiz to Teneriffe.

The Jubilee of the Electric Telegraph in Germany.

Germany, says the *Frankfurter Zeitung*, celebrates this year the jubilee of the founding of the electric telegraph, for it was in 1833 that the first telegraphic communication was established by Gauss and Wilhelm Weber, of Gottingen. After expatiating at some considerable length on the vast usefulness of the telegraph, throughout the world, the *Frankfurter Zeitung* concludes by saying that the number of telegrams sent every year averages 170,000,000.

Suits Against Telegraph Companies.

Suits were entered on behalf of the city of Philadelphia against the Western and Mutual Union and Philadelphia Local Telegraph Companies and the Bell Telephone Company for this year's tax upon poles and wires used by them. Similar suits brought last year are still pending in court. The city claims that the corporations are liable to a tax of $2.50 a mile on their wires, and $1 for each pole owned by them. The claim is resisted on the ground that the poles and wires being instruments of commerce are not subject to taxation, and that if the tax is levied as a police regulation it is excessive.

New Telegraph Companies.

NEW YORK.—The certificates of incorporation were filed here on 3d instant of three different telegraph companies. These are the Lowell District Telegraph Company, the Manchester District Telegraph Company, and the Lawrence District Telegraph Company. The lines of each company are to run from this city across Connecticut to Massachusetts, and thence to Lowell, Mass., Manchester, N. H., and Lawrence, Mass., respectively. Each company is organized with a capital stock of $60,000.

MONTREAL, CANADA,)
24th December, 1883.)

Editor Electrical Review:

DEAR SIR,—In acoustics it is said that the intensity of a sound depends upon the amplitude of the sonorous waves. Is that law holding good in the case of electric telephony? If we could increase the pressure upon the carbons by the voice (and here we would have a greater amplitude of the sonorous waves), would we have a greater intensity of the sound in the receiver? Were any experiments in this way?

Please give your opinion. We do not find that in any book.

Yours truly, A SUBSCRIBER.

ANSWER:

It is true that in acoustics the intensity of a sound depends upon the amplitude of the sonorous waves.

But in the electric telephone it is to be borne in mind that the *sound* is not in reality transmitted.

It is in the receiving telephone *reproduced;* and since the vibrations of a diaphragm, clamped at its edges, must necessarily be of a restricted nature, and since the sound at the receiving station is due to the waves of air produced by those vibrations, it is clear that the reproduced sound cannot have any great volume.

The amplitude of the vibrations of the receiving diaphragm depends, all things being equal, not upon the strength of current passing in the circuit, but upon the amount of variation in the strength of current. This, again, depends, not upon the degree of pressure with which the electrodes bear upon one another, but on the difference between the point of closest and the point of most precarious contact.

And a greater initial pressure would not, we think, tend to produce louder sounds in the receiver.

Experiments are constantly being made in this line by the American Bell Telephone Company at Boston.—EDITOR ELECTRICAL REVIEW.

Electrical Review,

FORMERLY REVIEW OF THE

Telegraph and Telephone.

Published Weekly at 23 Park Row.

P. O. BOX 3329.

GEO. WORTHINGTON, Editor. THOS. H. DELANO, Publisher.

SUBSCRIPTION.

United States and Canada, $3.00 per annum, in advance.

Great Britain and other foreign countries, $4.00, in advance. Postage free.

ADVERTISING.

Transient rate, 25c. per line each insertion.

"Business specials," 35c. a line.

EDITORIAL ANNOUNCEMENT.

Address all communications and make all checks and P. O. orders payable to order of Delano and Company, Proprietors. P. O. Box 3329, New York.

We invite correspondence from Electricians, Inventors and the Telegraph and Telephone fraternity on matters pertaining to electrical and scientific subjects, and all facts of special interest in connection therewith.

We extend to manufacturers of electrical apparatus an invitation to send to this office any and all facts concerning their business which will be of interest to the public. We make no charge for publishing news.

Those desiring to recommend their goods can do so to any extent in our advertising columns, but we will not publish for pay anything of the nature in our reading columns.

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NEW YORK, JANUARY 17, 1884.

CONTENTS.

	PAGE
The Brush-Swan System	1-4
A New Electric Motor	4
American Enterprise	5
Brush Electric Association of St. Louis—Arc and Incandescent Lighting	5
The Iowa Union Telegraph and Telephone Company	6
Rapid Extension of the Nebraska Telephone System	6
Presentation to a Telephone Superintendent	6
Telephone News from the South-West	6
Does the Direction or Route of a Line Increase or Decrease its Resistance	6
Telephonic Progress Made in Nashville	7
Storm Sounds in the Telephone	7
Boston's Telephone System destroyed by fire	7
The Jubilee of the Electric Telegraph in Germany	7
Suits Against Telegraph Companies	7
New Telegraph Companies	7
Revenue of the Telegraph Service in England	7
A Dutch Claimant for the Telephone	8
Gen. Sickles Storms the Manhattan Gas Works	8
Business Enterprise	8
Unique Electric Locomotion	9
Electricity and Wind Power	9
Look on This Picture and on That	9
Book Reviews	9-10
The Underground Matter Discussed	10
Relations of Fluidity to Galvanic Conductivity	10
Conversion of Light into Electricity	10
New Verification of Joule's Law	10
Average Market Quotations of Battery Supplies	10
Electrical Patents	11
Business Notices	11
Telephone Stock Quotations	11

A Dutch Claimant for the Telephone.

The controversy as to who invented the telephone is being carried on with increasing vigor by our esteemed contemporaries on the other side of the ocean. We must confess, and we hope they will pardon us for being so frank that it seems to us that the more they discuss this question the more mixed they become, the more involved in their own explanations and the farther off appears the goal to which, it is presumed, they are aiming.

Already we have three Americans, a Frenchman, a German and visions of an English claimant are looming up on the telephonic horizon. Sir William Thomson supports and urges the claims of Philip Reis, the German; the Comte du Moncel takes up the cudgels for Prof. Bell, the leading English electrical journal; the *Review* is inclined to look with something very much like favor upon Charles Bourseul, a Frenchman; and a very interesting writer named Barney may be said to have boxed the inventorial compass by supporting the claims of Bourseul, the American McDonough, and Elisha Gray, and another American consecutively. It seems to depend a good deal upon the season with Mr. Barney which of his favorites he will support. Last summer, if we are not very much mistaken, Mr. Barney was enthusiastic for Gray. In the fall when the leaves were falling from the trees, Gray, imitating their example, fell too, that is in the estimation of our volatile friend, Mr. Barney, and the McDonough case having come victoriously through the courts, the name of McDonough was adopted by Mr. Barney as the only, the "old original Jacobs." But with an exhibition of that variableness, that inconstancy which, it has been alleged, is inseparable from our sex, we grieve to see Mr. Barney now claiming the palm for Bourseul. This leaves a good many Richmonds in the field; but nevertheless, since all have had an opportunity to name the inventor of the telephone it may not perhaps be thought too bold on our part if we name our candidate as the inventor of the telephone. His name is Rhynvis Hwyckeneistmongiffinshock. It is not a pretty name, we concede that, but that is not our fault nor his either for that matter. It is claimed that in 1854 Bourseul invented something very much like a telephone. He communicated his invention of the telephone to the French Academy at the date named, and further there appeared an article describing what he had done in the line of transmitting sounds electrically, in the *Didaskalia*, a supplementary paper to the *Frankfurter Journal*. Bourseul's invention is thus described in that publication:

"An electric current passing through a wire transforms a piece of soft iron into a magnet. If the current ceases the magnetism also ceases. This electro-magnet can be made to alternately attract and release a movable plate, which in its to-and-fro movements produces the conventional telegraphic signals. Now, it is also known that all sounds which reach our ear are produced by vibrations in the air, and that the infinite variety of sounds depends solely on the speed and magnitude of these sound-waves. If, now, a metal disc could be invented which would be flexible enough to reproduce all the sound-waves transmitted to it by the air, and if that disc could be connected to an electric circuit—such a way that in conformity with the vibration of the air it would start and interrupt the current—then it would also be possible to cause a similarly-constructed metal disc, in electrical connection with the first, to repeat all the movements of it, and the effect would be the same as if one had spoken directly against this second disc—that is to say, the ear would be affected in the same manner as if it heard the speech directly through the first metal diaphragm."

So much for the Frenchman. Then comes a German; three Americans, and a possible Englishman. Surely the introduction of one Dutchman into this bevy of intellectual pulchritude cannot in reason be taken exception to. We will therefore proceed without further circumlocution, to state his claims.

Rhynvis Hwyckeneistmongiffenshock was a friend of Hans Christian Oersted who, at the beginning of this century had a world-wide fame as a natural philosopher. In 1820 the latter published his celebrated treatise: "Experimenta circa Efficacian Conflictus Electrici in Acum Magneticam." In this he contended that there is always a magnetic circulation around the electric conductor, and that the electric current, in accordance with a certain law, always exercises determined and similar impressions in the direction of the magnetic needle, even when it does not pass through the needle, but near it. Oersted had them working in Rudkjoping, and Hwyckeneistmongiffenshock hastened thither to join him, having become peculiarly interested in the subject. Now, it was at this time that Sir Humphrey Davy and his assistant, Faraday, were engaged in developing the great discovery of Oersted's on the relations of electricity and magnetism which has been described above, and it was not long before the news came that Faraday had performed for the first time the remarkable experiment; developing the close connection of those two forces, of causing a magnet floating on mercury to revolve continuously round a conducting wire, and again a conductor to rotate round a fixed magnet. The magnet, still more wonderfully, was made to revolve with great rapidity when an electrical current was passed over half its length.

Upon the receipt of this intelligence both Oersted and his assistant Hwyckeneistmongiffenshock set themselves diligently to work to still further develop the principle of which the former had discovered the germ. In doing this the pupil far outstripped the master, and in a letter sent by him to Holland and published in the *Vaderlandsche Letterolfningen* Rhynvis Hwyckeneistmongiffenshock claims that he can transmit sounds a short distance with great clearness. This was in 1821. He was inclined, as several others since have been, to regard this electrical transmission of sound as of little value out of the laboratory, and therefore never troubled himself to perfect an instrument, or if he did, it has not to our knowledge been recorded.

The Comte du Moncel in his paper, wherein he claims that Bell was the true inventor of the telephone, says:

"Le veritable inventeur, selon nous, est celui qui a reconnu le principe servant de base aux effets télephoniques et qui a combine le premier, pour produire les courants ondulatoires et traduire leurs effets par des sons perceptibles à l'oreille. * * * * Pour nous, qui restons toujours dans l'intime conviction que l'invention du telephone *reside entierement* dans la decouverte du moyen de rendre l'intensité du courant électrique fonction de l'amplitude et de la forme des vibrations sonores, de la découverte des courants ondulatoires. * * * * Pour nous, le véritable inventeur est celui qui rend pratique une invention et qui obtient des resultats *constants* bases sur des principes raisonnes."

If the true inventor is he who recognizes the principles that will serve as a base and can construct upon them an apparatus by which intelligible sounds may be transmitted to the ear, then he may fairly claim the invention of the telephone for our Dutch friend; but if, as du Moncel says further along, the true inventor is he who renders a mechanism fit for practical use, then, and it grieves us to say it, Rhynvis Hwyckeneistmongiffenshock was *not* the inventor of the telephone.

Gen. Sickles Storms the Manhattan Gas Works.

The year that is ended was by no means a satisfactory one to the gas companies. Not that they lost money, for this was by no means the case. They made their usual large hauls; they did their customary amount of browbeating and exacted the pound of flesh from that portion of the public that was in their power with their usual mercilessness. But it was during the last year that the electric light—that bugbear which they have learned to laugh at—gave positive evidence of its efficiency as an illuminant. In short, it is now only a question of time, as all men of intelligence know, when the electric light must usurp the place now occupied by gas as an illuminant.

The public is surely to be congratulated that this is the case. It has become as disgusted with the manner in which these gas companies are wont to conduct their business, as with the noxious fumes which they force through their pipes.

The gas company is a law unto itself. It has not been in the habit of subjecting itself to the restraints which the law imposes upon other corporations and individuals. We speak only of American gas companies. If your butcher overcharges you, you inform him of the fact, and it is ten to one he will exhibit a willingness to look into the matter, and have it fairly adjusted. Not so the gas company.

You have no right to doubt the correctness of a bill rendered by the gas company, and if you have the hardihood to do so you will live to regret it. The gas company has a summary method of procedure under such circumstances. It cuts off your gas, and seizes upon the month's installment which you are required to leave with it when it begins to serve you with gas; or, rather, when you begin to serve it as a victim. This generally ends the matter. You can't have your household left in darkness on account of a few extra dollars which the company claims is due it. You might as well try and argue with the highwayman that the purse which he demands of you he has no title to.

We prefaced these remarks by saying that the year that is ended was by no means a satisfactory one to the gas companies, but this is not wholly due to the immense strides which have recently been made throughout the United States by the electric light. Knowing that they had the electric light to fall back upon, a certain portion of the public has taken heart and refuses longer to tolerate the extortions of the gas companies. The tricks of these companies have been fully explained to an indignant public, and the result is shown by a deep-rooted determination on the part of the public to rid itself of all connection with the extortionate gas companies, their insolent servants, and their bad smelling, disease-spreading illuminant.

Those who know the inside workings of the gas company, are aware that the policy is to bully the timid and to fight very shy of those who show a disposition to resist. But greed often blunts the judgment, and so it occasionally happens that the gas companies mistake their customers and get into a peck of trouble before an opportunity offers of resorting to their favorite method of escape, viz: by flight.

It was under such circumstances that the Manhattan Gas Light Company of New York got its fingers somewhat badly scorched just before the close of the past year, and this should pass as a warning to other gas companies as long as they exist for the purpose of supplying illuminating gas, which, let us hope, will not be long.

Gen. Daniel Sickles, a one-legged veteran of the late war, arrived back from Europe, some months since, just in time to be confronted by the agent of the Manhattan Gas Light Company with a heavy bill. He told the latter that, as he hadn't used any gas, he didn't owe the company anything; whereupon the agent, becoming somewhat offensive, Gen. Sickles thrust him into the street. The following day a peremptory order was received from the Manhattan Gas Light Company to the effect that he must pay the bill that had been presented, and threatening that in case of refusal the gas would be shut off.

In answer, Gen. Sickles served them with an order from the Supreme Court forbidding any such summary proceeding. The Court held that the public had rights as well as gas companies; that statements made by consumers must be regarded as reliable as those made by gas companies, and that thus to attempt to force the payment of a bill which

was contested was unjust, illegal, and not to be tolerated.

With a shrewdness that does him credit, Gen. Sickles, instead of "giving away" his case to the gas people, under which circumstances they would assuredly have failed to contest it, refused point blank to pay the bill, on the ground that the charges contained therein were untrue. He ended by defying them to contest it in court.

Chief amongst the many things the Manhattan Gas Light people will have reason to regret in after life will be that they accepted his challenge.

When the case was called in court, the Manhattan people testified that a recent inspection and test of the gas-metre in Gen. Sickles' house had shown that, instead of the gas bill rendered being too large, it was, in fact, much too small; that the metre by no means registered all the gas that had been used in Gen. Sickles' house.

Then Gen. Sickles, taking the witness-stand, threw a bombshell into the Manhattan Company's camp that spread consternation. He testified in substance that during the period in which the company had charged him for gas *he and his family were in Europe, and the house was locked up.*

Even the adamantine "cheek" of a gas company was not proof against this.

The evil practices of the gas companies, and the unhealthfulness of their fluid, have been discovered. They must go! *Obruat illud male partum, male retentum, male gestum imperium!*

Business Enterprise.

The individual who can grasp the substance of a business problem, solve the intricate, and sometimes delicate, questions involved, and has the energy to push the project to its utmost limit, is the man who wins. The development of the electrical industries, with their vast capital, far-reaching usefulness, and, as yet, unfathomed utility to the wants of modern society, has demonstrated beyond doubt that a legitimate business enterprise, backed by a clear head and a courageous purpose, will be victorious in the end, no matter how bewildering or discouraging it may look at the outset. The telephone and electric-light properties, valuable as they are to-day, have been made largely, we may say almost wholly, by the long hours of toil, the constant and faithful efforts of their projectors and energetic managers.

This country gives greater opportunities for the young to enter upon a successful career, and is more liberal in her encouragement of thrift and industry than any other on the face of the globe. Thus it is that we have been enabled to outgrow all the nations of the earth, and build up electrical enterprises of vast importance. As an instance of the rapidity with which success has been achieved and a permanent and prosperous business established, the American Bell Telephone Company more than proves.

Scarcely two years ago an electric-light company, little known outside of New England, began the up-hill work of finding a position for its system among those already in the field. The outlook was not encouraging, but by persistent and praiseworthy efforts the minor difficulties were overcome, and to-day the Thompson-Houston system of electric-lighting is well-known throughout the world. It has increased as a property a thousand-fold. All credit should be given to those who have applied, no less industriously, their fertile brain to the solution of scientific questions, and the production of economical dynamos and appliances as a basis for successful operations; and who have by patient toil and almost ceaseless experimenting brought out of the chaos of theory and tradition, something that can be utilized for the benefit and happiness of humanity.

Too much cannot be said in praise of such men among us as Thomson, Weston, Brush and Edison, or of others less prominent, perhaps, but no less industrious, whose fruitful minds have produced so abundantly. But, however great they may all be, there are others just as industrious, just as energetic, and just as deserving of credit; for their efforts have made it possible to enjoy to the fullest extent the fruits of their labor. Every day some new enterprise is started that would never see the outside of a laboratory or experimental state of existence, were it not for these same men. As an instance of the rapidity with which important moves are made and new enterprises started, we refer our readers to a letter from our Canadian correspondent, giving facts of great importance and the details of a brilliant move by the American Electric and Illuminating Company, of Boston. President Goff seems to be more than ever watchful over the interests he has to protect, and more energetic in his efforts to increase and permanently build up the property under his control.

Unique Electric Locomotion.

New modes of electrical locomotion are continually being discovered. We have the charged-rail system, the third rail system, overhead contact motor, and the secondary battery motor. Recently we have had described the telpherage system, intended solely for freight, and now an ingenious man has invented a system for letter and package transportation that is as fast—we were going to say, as fast as the wind; but, as a hurricane rarely exceeds seventy miles an hour, and the new motor is good for from one hundred and fifty to two hundred miles per hour, the wind cannot be compared with it in velocity.

This new system, if practicable, which, to our mind, is by no means yet assured, would deliver packages with the celerity of electricity, considering the delays which a dispatch is usually subjected to at both ends of the line. This system has been invented by Mr. F. Hahn Danchell, chief engineer, and is being exhibited by a working model at the offices of Messrs. Bauer & Co., No. 6 Union Court Chambers, Old Broad street. The main object of the inventor is to obtain a high rate of speed with a light load, and this system has been specially designed for the transport of letters, parcels, and light-weight goods. The distinguishing feature in the construction is that the train runs on one rail only instead of two, and it is balanced by another rail overhead, which is embraced by pairs of side guide wheels attached to the upper part of the train. This upper rail is made to act as the conductor of the electric current from the generating station, the current being transmitted to the driving machinery on the engine, which runs upon a pair of central grooved wheels of large diameter. The object of this construction is to reduce friction to a minimum, and thus to facilitate the attainment of high speed, which Mr. Danchell proposes should be from one hundred and fifty to two hundred miles per hour. The speed attainable will, of course, depend chiefly on the power that can be obtained from the motor. The working model consists of a circular railway, about eight feet in diameter, the engine being about twelve inches long by eight inches high, and the power being furnished by an ordinary bichromate battery. The speed attained is very great, and Mr. Danchell states that experiments on a much larger scale have already been carried out at Maidstone. He proposes primarily to supply the system to the transmission of letters and parcels—in fact, for postal purposes, for which it would appear to be adapted.

Electricity and Wind Power.

The question relative to the electrical storage of wind power is likely to prove of great importance in the future. There is good reason to believe that wind-mills will be utilized on a grand scale to store up electrical energy either for transmission in batteries or by wire. Hence, everything concerning the action of winds must prove of interest to electricians.

We do not mean to imply that the wind-mill cannot now be utilized to store electrical energy, for the experiment has been tried frequently with success, but the unequal movement of the wind and its inconstancy has made it necessary to find an apparatus by which this unevenness may be counteracted or at least lessened, so far as the action of the wind upon the interposing apparatus is concerned.

One of the first things to be observed in a storm is the way the wind acts. It does not blow regularly, but it gusts. At one moment it bends over the branches of the trees; in the next it has loosened its hold and let them fly back. We see it swelling out a ship's sails into a puff; in a minute later the sails hang flapping as if they had been struck down.

We cannot account for these phenomena and explain the intermittence of the wind puffs by assuming that the molecules of air, displacing each other, excite a vibratory movement, which gives rise to little undulations following one after another at intervals of a few seconds. The resultant of a series of these undulations is a puff of wind which comes on suddenly, and is followed by a short lull. A series of puffs constitutes a squall, and an aggregation of squalls forms the atmospheric wave which is called a gale of wind. We should naturally expect to observe the same phases in the formation of the sea waves; and, in fact, if we carefully examine a wave we shall find that it is covered with very fine ripples that correspond to the atmospheric vibrations. The ripples give rise to wavelets, which correspond to the undulations of the air, and are seen on the upper part of the waves. The wave proper appears to consist of a series of wavelets. A number of waves constitute a billow, a series of billows give rise to a heavy sea (*paquet de mer*), a series of heavy seas produces the great swell or tidal wave of the storm.

From the nautical point of view the ripples are of no importance, for they are seldom more than a few millimeters in diameter, but from the scientific point of view they may be considered as the origin of the swing of the liquid element, for they engender the wavelets. The last are still of no interest to the sailor, but are important in their relation to works of art, which are disintegrated by their blows, apparently insignificant but infinitely multiplied. The wavelets are from ten to thirty centimeters in diameter and not very long. A very heavy wind breaks them up and contributes to the formation of a fine dust of salt water or salt spray, which is destructive to vegetation on exposed coasts. The wave proper may, in the English Channel, be about ten feet high, thirty feet or more broad, and eighty feet long; its proportions do not disturb large ships, but it is destructive in the long run to port works, and is dangerous to small craft when it breaks. We may estimate that ten waves make a billow. The first of the ten may be relatively small, but the others go on increasing to the last.

Look on This Picture and on That.

Editor of Electrical Review.

[From the New York Tribune.]

"NEW HAVEN, December 19.—The Peck, How & Wilcox axe factory at Cheshire was set on fire this morning by the explosion of a kerosene lamp, and was totally destroyed. Loss, $25,000; insurance, $12,000. About seventy men are thrown out of employment."

The above item is only one in a thousand which are printed in the New York dailies, and tells its own story. I cite it at this time to show your readers and the general public that the danger from electric light wires is somewhat less than those of kerosene or gas. Somewhat? *Slightly?* Yes, I may say *considerably* less than either of the last-mentioned illuminants. I say this boldly, without fear of contradiction; for the most ardent admirer of gas or devoted disciple of kerosene cannot deny the facts you have so kindly placed before all who can and *will* read them.

Briefly, here are the figures: Loss of property by arc lighting, nothing; by overhead incandescent lighting, $10; by underground incandescent lighting, $75—total, since the beginning, $85. The above item shows a total loss in one night, by kerosene, of $25,000 against $85 in four years by electricity.

But, taking it upon another basis, we find that loss by kerosene in the cases mentioned exceeds that caused by electricity by a fraction over 294 per cent. And this ratio will be more than verified in the case of either gas or kerosene, were the facts always published.

About the same time several dailies reported the case of a man who was smothered by gas while sleeping at a hotel in this city, and within the last four months two more deaths, caused by the same agent, have been duly reported. Total, three lives lost directly traceable to gas during four months, or an average of nine lives a year. At this low rate we would have, in New York alone, during a period of four years, an aggregate loss of thirty-six lives.

Surely the editors of our daily papers must feel ashamed of themselves for maliciously attacking a peaceful and harmless business enterprise, composed of intelligent and honest men, without first ascertaining all the facts. Isn't it time that they made some explanation of the motives which prompted the vituperous onslaught? Certain it is that the public will not again be deceived by a ruthless attack of falsehood and misrepresentation for the purpose of promoting private money-making schemes, or the tearing down of overhead wires.

J. R. B.

New York, Dec. 26, 1883.

Book Reviews.

THE ELEMENTS OF CHEMISTRY FOR THE USE OF SCHOOLS, ACADEMIES AND COLLEGES—BY EDWIN J. HOUSTON, A.M., PHILADELPHIA, ELDREDGE AND BROTHER, PUBLISHERS.

Many an electrician and experimenter has seached in vain among the standard chemical works for the theory of recent discoveries in chemical science, and wondered why chemical writers were so rarely abreast of the times. Now, we will not attempt to answer this conundrum for the very good reason that we don't know ourselves, but will rest content with the introduction to our readers of Prof. Edwin Houston's new work in which chemical science is brought down to the present time. More than this, it is written concisely and clearly, without verbiage or those long explanations, which from boyhood up, have puzzled many of us where this very length of explanation, it was believed, would be our salvation, and some of us have found ourselves stranded upon the very safeguards that were intended to lighten up our way.

If we had not known that Prof. Houston was an experienced instructor, we should have surmised it by his carefully arranged explanations. He makes a thing clear when it is first proposed, whereas the merely scientific writer will so becloud his meaning that you may meet a proposition with which you are well acquainted and not recognize as easily as one may pass his nearest friend in a masquerade.

This little work of Prof. Houston's is a refutation of the claim that has often been put forward by scientific writers, that applied science could not be made plain to the general reader even if intelligent. From the beginning to the end of his book Prof. Houston is readily understood, and the "quiz" he gives us here and there is a novel and excellent feature of the work of this kind, though we must confess we think it would have been greatly enhanced in value had he appended the answers, or placed them at the end of the book.

An attempt has been made in this book, says the author, to present in logical sequence the latest developments of chemical science. Among the innumerable facts of chemistry, those only have been introduced that are either of practical importance or of such theoretical value as to be necessary for the elucidation of chemical theory. By so doing

space has been gained for information generally confined to more extensive treatises.

Comparatively extended space has been given to the nature of the chemical force; to the ideas concerning atoms and molecules; to gaseous combination by volume; to the theory of atomicities, and to the theory of replacement or substitution, since clear conceptions of these principles are essential to any sure progress in chemical science.

The quantivalence of the elements, says Prof. Houston, and the influence of such quantivalence on the complexity of molecular structure are repeatedly impressed on the mind of the student by the frequent introduction of graphic formulæ. With the same view, all important reactions are given in full.

This volume is intended for academies and schools, and its contents are arranged in a convenient form for the student. How well its author expresses himself may be gained from the following: Like heat, light is capable of influencing both chemical combination and decomposition. Its more general action is in effecting decomposition.

A mixture of chlorine and hydrogen, that will not combine in the dark, combines explosively when exposed to full sunlight. Certain compounds of silver are readily decomposed by the influence of light; photography is based on such decompositions. Carbonic acid, a combination of carbon and oxygen, absorbed by the leaves of plants, is decomposed by the sunlight; the carbon is retained for the production of woody fibre, and the oxygen thrown off.

The fading of such colored fabrics as carpets and curtains is caused by the decomposition of their coloring matters by the sun's light. Chemical union is often determined by electricity. An electric spark, passed through a mixture of certain gases, such, for example, as oxygen and hydrogen, causes them to enter into combination. Here the spark evidently acts by its heating power, since a flame will produce the same effect.

In the same manner the more intense heat occasioned by passing a number of sufficiently powerful electric discharges through certain compound gases, will effect their decomposition. Electricity, however, apart from its heating effects, is a powerful agency in producing both chemical combinations and decompositions. These combinations and decompositions are effected mainly by means of the current developed by the Voltaic pile.

The Underground Matter Discussed.

Mr W. H. Knight, of Washington, met a number of electricians and representatives of various electrical companies on Thursday last at the rooms of the Down-Town Association, and explained the Knight and Bentley system of laying wires in a conduit placed under ground. Among those present were Col. Hazard, of the General Committee on Underground Communication; E. N. Dickerson, Alexander Holmes, Mr. Wright, T. C. Montgomery, of the Brush Company; Major Eaton, of the Edison Company; Mr. Gilman, Jose De Navarro, Mr. Adee, and Gen. C. C. Dodge. It is claimed that a feature of the system is the overcoming of the induction from telegraphic to telephonic wires by the use of a return wire through the conduit They also claim that this would counterbalance the induction of the other wires. Their scheme is to place the electric light wires on the sides of the conduit, and to prevent the disturbance by induction, the cable containing the telegraph wires crosses and recrosses at regular intervals from one side to the other, thus making a system of balance and average. The conduit would be made of wood or terra cotta. At frequent intervals along the conduit there would be junction boxes, at which points connection would be made with branch conduits to houses. The wires would be pulled through from one junction box to another and could be taken out without disturbing the pavement. A conduit 2 feet by 2½ would carry 15,000 wires. Every conduit would be furnished with a safety cap to prevent disturbance from an abnormal current.

We shall discuss this matter at length in another issue.

The following rules of safety against all dangers likely to accrue from electric lighting have been adopted by the leading German fire offices, in conformity with the experience gained hitherto, slight though it may be:

1. *Arc lamps* must not be put up in places in which inflammable or explosive solid or gaseous materials are to be found, or may possibly get mixed up with the air. In all other places arc lamps may be applied; but when materials likely to take fire are lodged or manufactured in such places, it becomes imperative to enclose the lamps in globes or lanterns, sealed up below with an ash tray. In those places in which open arc lamps may be used it is yet essential that an ash tray of at least eight inches in diameter should be put below the lamp.

2. *Incandescent lamps* may be put in any place; yet, whenever and wherever inflammable or explosive solid or gaseous materials are in existence, or may get mixed up with the atmosphere, each lamp must have a glass globe around it, within which the connection between the conductor and the lamp is to be placed. It depends on future experience whether the above rules are likely to prove sufficient for all emergencies or not.

Relations of Fluidity to Galvanic Conductivity.

Carl Stephen gives the following equation:

$$k = \frac{w K H}{w' \eta}$$

in which K represents the conductivity of a water solution of the same temperature and percentage as an alcoholic solution with which it is compared; H and η, the internal frictions of the water and of the alcoholic fluid, for the same temperature; w and w', the percentages of water in the alcoholic solution and in a mixture of alcohol and water of minimum fluidity. He gives the following conclusions: 1. The frictional coefficient of many mixtures of water and alcohol, as well as the galvanic conductivity of diluted solutions of various salts, can be readily estimated. 2. The conductivity of diluted alcoholic solutions increases more slowly, when the amount of salt is increased, than that of water solutions. 3. The temperature coefficients of the conductivity of diluted solutions correspond very nearly to those of the fluidity of the solvent. 4. The conductivity of the alcohol-and-water solutions may be deduced from that of the corresponding water solutions, by a factor which depends only upon the solvent, and is the same for different salts. 5. If the proportion of alcohol is not greater than that of water, the conductivity is very nearly proportional to the fluidity of the solvent.—*Ann. der Phys. and Chem.*

New Verification of Joule's Law.

M. Alfred Reinisch writes in the *Zeitschrift des Electrotechnischen Vereins in Wien* as follows: When we wish to use lead wire as a safety plug in an installation of arc or incandescent lamps, it is necessary to ascertain what current a wire of a given section will stand before fusing. In practice we content ourselves with allowing eight ampères as a maximum current per square millimeter of section of lead wire, and we adopt as secure a wire of two or three times larger section. Suppose, for instance, the case of an electrolier with 30 Swan lamps on it, each receiving a current of 1.4 ampère, it would be necessary, to be trebly secure, to adopt a lead wire of 15.95 square millimeters in section. It has been thought convenient to always maintain the same section for the lead wire, whilst varying its length. To this end different lengths of this wire, of two millimeters diameter, have been submitted to varying currents, and the mean values of the number of ampères required to fuse a length of wire determined, as follows:

Length.		Current.	
100	millimeters	38.74	ampères
90	"	39.88	"
80	"	40.01	"
70	"	41.24	"
60	"	43 60	"
50	"	46.91	"
40	"	50.01	"
30	"	56.80	"
20	"	66.84	"
10	"	87.35	"

By taking the lengths as abscissæ and the ampères of current required to fuse the lead as ordinates, a hyperbolic curve is obtained, which is similar to that obtained by Joule's law, and the latter is therefore confirmed anew.

Conversion of Light into Electricity.

The conversion of electricity into light (says *Engineering*) is now a fact of every-day utility, but the reverse process has been very slow of accomplishment. It has, however, been effected by Herr Sauer, whose sunlight battery has been described in the *Electrotechnische Zeitschrift*. The chemical rays furnish the power, and the battery will only act in sunlight. It consists of a glass vessel containing a solution of fifteen parts of table salt and seven parts of sulphate of copper in 106 parts of water. In this is placed a porous cell containing mercury. One electrode is made of platinum, and the other of sulphide of silver, and both are connected with a galvanometer. When not in use the whole is enclosed in a box. When in use, the platinum electrode is immersed in the mercury, and the other in the salt solution; the battery is placed in the sunlight, and the galvanometer needle is then found to be deflected, the sulphide of silver being the negative pole. If the sun is clouded, or any other change in the intensity of the light occurs, it is indicated by the needle. The exact effect produced by the light rays does not as yet appear very clear; but their presence distinctly produces electrical action, and their absence suspends it.

The Brush Company's New York business, according to Mr Rowley, the General Manager, employs 1100 arc lights and 2700 incandescent lights now running, with a constant and steady growth. The introduction of the storage batteries is disappointingly slow, but the managers of the company seem to be as hopeful as ever of doing a large business with the system. The question of putting the wires underground has not troubled the company yet, as there are two years in which to do the work. The only practical method, according to Mr. Rowley, will be to build an underground viaduct, seven or eight feet square, in which all the wires used by the different companies—lighting, telegraph, telephone, and others—can be placed and examined and repaired at will, without disturbing the streets.

The American Electric and Illuminating Company, of Boston, have formed a company at Chelsea, Mass., to operate three hundred Thomson-Houston Company lights, and will also open up business in March at Cambridge and Nantasket, and early in the spring at Mt. Desert and Bangor. Messrs. Goff and Hovey have instilled some of their radiant energy into the electrical field in New England.

The National Electrical Company, organized recently at Washington, D. C., by Geo. C. Maynard, well known in the telephone field, advertise to introduce electrical appliances of every description.

Messrs. C. M. and E. Ward Wilkins have recently been admitted to the membership in the firm of Partrick & Carter, of Philadelphia, manufacturers of telegraph, telephone, and electrical supplies. The new team is a strong one, and we wish them continued success.

The Brush Electric Light Company, of New England, have just declared a dividend of 5 per cent. payable at once.

The following new enterprises in which Brooklyn capitalists are interested filed certificates of incorporation with the Secretary of State:

The Wurtz Fuel, Gas and Electric Light Company, of New York, formed to purchase, develop, lease and sell patents and devices in the art of manufacturing and applying water gas, and of applying electricity to various purposes. Capital stock, $1,000,000. The incorporators are O. A. Wilcox, Myron C. Barton and Charles P. Young, of New York, and Byron A. Brooks and Edward Bolithe, of Brooklyn.

Proposals for lighting the electric lights along Chestnut Street and Delaware Avenue, Philadelphia, were made, and the contracts awarded as follows: For Chestnut and Market, west of the Schuylkill River, to the Brush electric light; for lighting Delaware Avenue to the Maxim Company at sixty cents per lamp for each night. The lights are required to be of 2,000-candle power, fourteen hours daily when required between sunset and sunrise.

An electric arc lamp on a new principle which has been invented and patented by Messrs. Clark and Bowman, was publicly exhibited recently in London. The main feature of the lamp consists of an improved form or clutch, in which the carbons are fed by very small impulses, and the length of the feed is determined by the clutch. The feed can be regulated at will while the lamp is burning. Among other advantages the inventors claim that the lamp contains less moving parts than any other.

For several years past experiments have been in progress with the electric light in French light-houses. The results are sufficiently satisfactory to encourage a more extensive use of electric light for this purpose, and of the 382 light-houses which are scattered along the French Atlantic, and Mediterranean coasts, 42 will receive electric light immediately. The experiments show that when provided with the electric light the light-houses on the English Channel and on the Atlantic coast will remain visible for at least ten months of the year.

Within the past two months quite a number of Maxim incandescent plants have been installed in Boston's business section, and more are going in. They are all run on a long circuit.

The Broadbrook Company, Conn., have contracted for a 50-light incandescent plant.

The Holyoke Warp Company, has recently installed a plant of 11 Weston arc lights.

A New Storage Battery.

Patents have been granted within the last two weeks to Willard E. Case, of Auburn, N. Y., for a new electric storage battery much simpler than any now in use. The chief feature of the invention is the manner of making the lead plate, which consists in melting the lead and putting in peroxyde of lead as the mixture cools. In the Faure battery the lead plate is coated with peroxyde, held in place by a felt covering. The new process is said to make a better plate, and does away with the necessity of coating the plate and with the use of felt.

The New York and Brooklyn Electric Light Company have introduced the Parker incandescent light in the United Bank building, on Broadway.

Average Market Quotations of Battery Supplies for the Week Ending January 10, 1884.

Zincs (crow foot)	48c. each
Copper	9½c. each
Jars (according to size)	35 to 60c. each
Blue vitriol	6½c. lb.
Sal ammoniac	12½c. lb.

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ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENT OF THE UNITED STATES WERE GRANTED IN THE WEEK ENDING JANUARY 8, 1884.

291,483 Electrical indicator and alarm; William H. Barker, Brooklyn, N. Y.

291,484 Electrical indicator and alarm; William H. Barker, Brooklyn, N. Y

291,505 Secondary battery; Eusebius J. Molera and John C. Cebrian, San Francisco, Cal., said Molera assignor to said Cebrian.

291,553 Electric arc lamp; Chas. J. Van Depoele, Chicago, Ill.

291,554 Regulator for dynamo-electric machines; Charles J. Van Depoele, Chicago, Ill.

291,556 Electric railway signal; William Vogel, Chicago, Ill., assignor of one-half to William T. Underwood and Bernhard Schram, same place.

291,576 Regulator for dynamo or magneto-electric machines; Foree Bain, Chicago, Ill., assignor to Bain Electric Company, same place.

291,575 Electrically-actuated sheet stop for printing presses; Andrew Campbell, Brooklyn, assignor to John McLoughlin and Edmund McLoughlin, New York, N. Y.

291,590 Magneto-electric railway signal; Wesley Ward Gary, Boston, Mass.

291,636 Electric motor; Levi W. Stockwell, Cleveland, Ohio.

291,648 Electric circuit closer; Charles J. Van Depoele, Chicago, Ill.

291,649 Electric safety cut-out; Charles J. Van Depoele, Chicago, Ill.

291,650 Current regulator for electric motors; Charles J. Van Depoele, Chicago, Ill.

291,651 Electric lamp; Charles J. Van Depoele, Chicago, Ill.

291,652 Safety cut-out for series of electric lamps; Charles J. Van Depoele, Chicago, Ill.

291,653 Electric arc lamp; Chas. J. Van Depoele, Chicago, Ill.

291,684 Telephone; Jos. H. Cheever, Somerville, Mass.

291,715 Underground electrical conductor; John Greives and John H. Bleoo, Paterson, N. J.

291,716 Electrical insulating material; John Greives, Paterson, N. J.

291,717 Electrical insulating material; John Grieves, Paterson, N. J.

291,718 Electrical insulating material; John Grieves, Paterson, N. J.

291,721 Railway signal system; William Hadden, Brooklyn, N. Y.

291,731 Insulating connection for electric light gxtures; Charles H Hinds, New York, N. Y.

291,758 Conduit for underground electric conductor; Eli T. Starr, Philadelphia, Pa., assignor of one-half to William J. Peyton, Washington, D. C.

291,802 Receiving telephone; Lyman W. Sutton, Jr., Newton, assignor to John F. Phillips, Jersey City, N J.

291,825 Cut-out for telephones; Austin Williams and Joseph M. Gannon, Negaunee, Mich.

291,850 Storage battery; Edward R. Knowles, Brooklyn, N. Y., assignor of one-half to Byron A Brooks, same place.

REISSUES.

10,434 Hydraulic and electric interlocking apparatus; Oscar Gassett, Boston, Mass., assignor by mesne assignments to Robert Pitcairn and George H. Christy, trustees, Pittsburgh, Pa.; original number, 266,957, dated October 31, 1882.

10,435 Hydraulic and electric interlocking apparatus; Oscar Gassett, Boston, Mass., assignor by mesne assignments to Robert Pitcairn and George H. Christy, trustees, Pittsburgh, Pa.; original number, 266,957, dated October 31, 1882.

A printed copy of the specification and drawing of any patent to the annexed list, also of any patent issued since 1865, will be furnished by any of the patent solicitors whose advertisements appear in this journal. In ordering please state the number and date of the patent desired.

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No. 119,561	October 3, 1871	No. 199,676	January 29, 1878

Others pending.

SINGLE HAND GAS LIGHTING APPARATUS.

No. 116,054	June 20, 1871	No. 203,406	May 7, 1878
No. 146,953	January 27, 1874	No. 206,272	July 23, 1878
No. 152,427	June 23, 1874	No. 209,016	October 15, 1878
No. 177,459	May 6, 1876	No. 225,971	March 2, 1880
No. 180,832	August 8, 1876	No. 259,267	June 6, 1882
No. 180,833	August 8, 1876	No. 279,634	June 19, 1883
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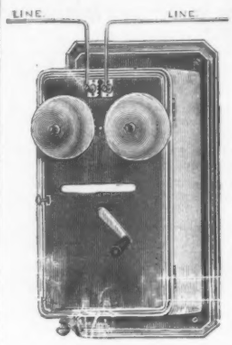

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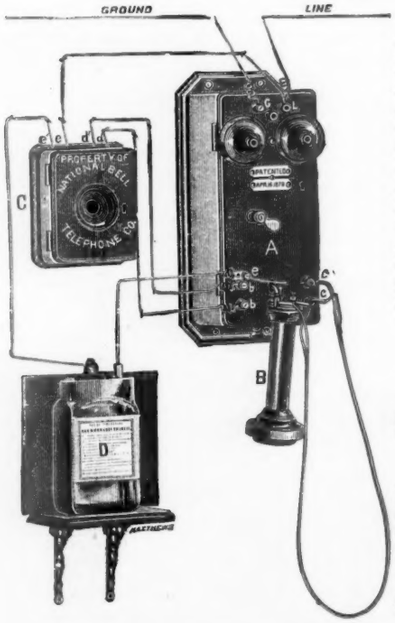

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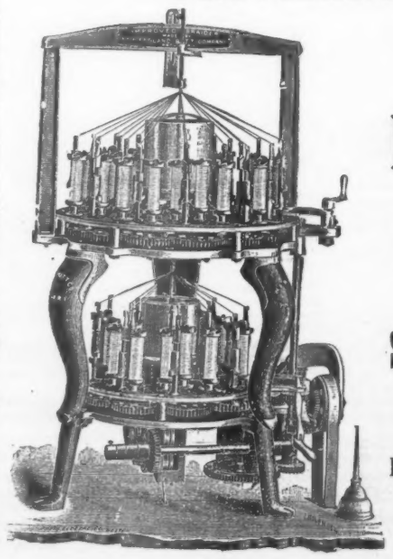

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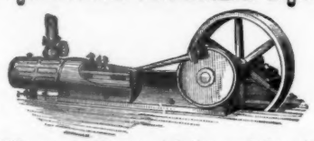

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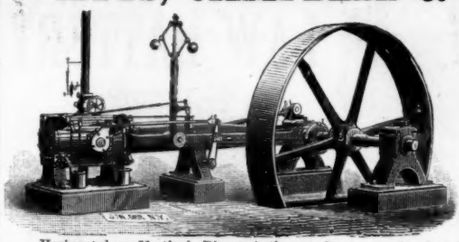

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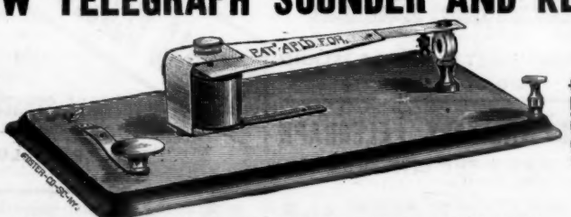

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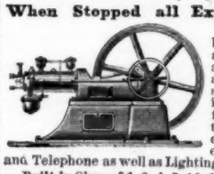

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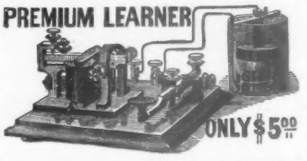

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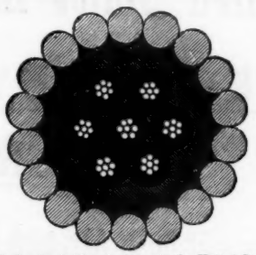

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